WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

A Scranton Gillette Publication

The New Operations Building of the Indianapolis Water Co.

MAY 1957

Water Works Liability to Property Owners for Fire Losses

How to Increase Revenue Without Raising Water Rates

THE RING TRICK

The time-honored ring trick always keeps the audience guessing, and if you like guessing games, perhaps you would like to guess how many tons of steel joint rings went into the construction of the City of Tulsa's 275,000 foot 72″ and 66″ Lock Joint Concrete Pressure Pipe water supply line. You'll find the answer concealed in the picture above.

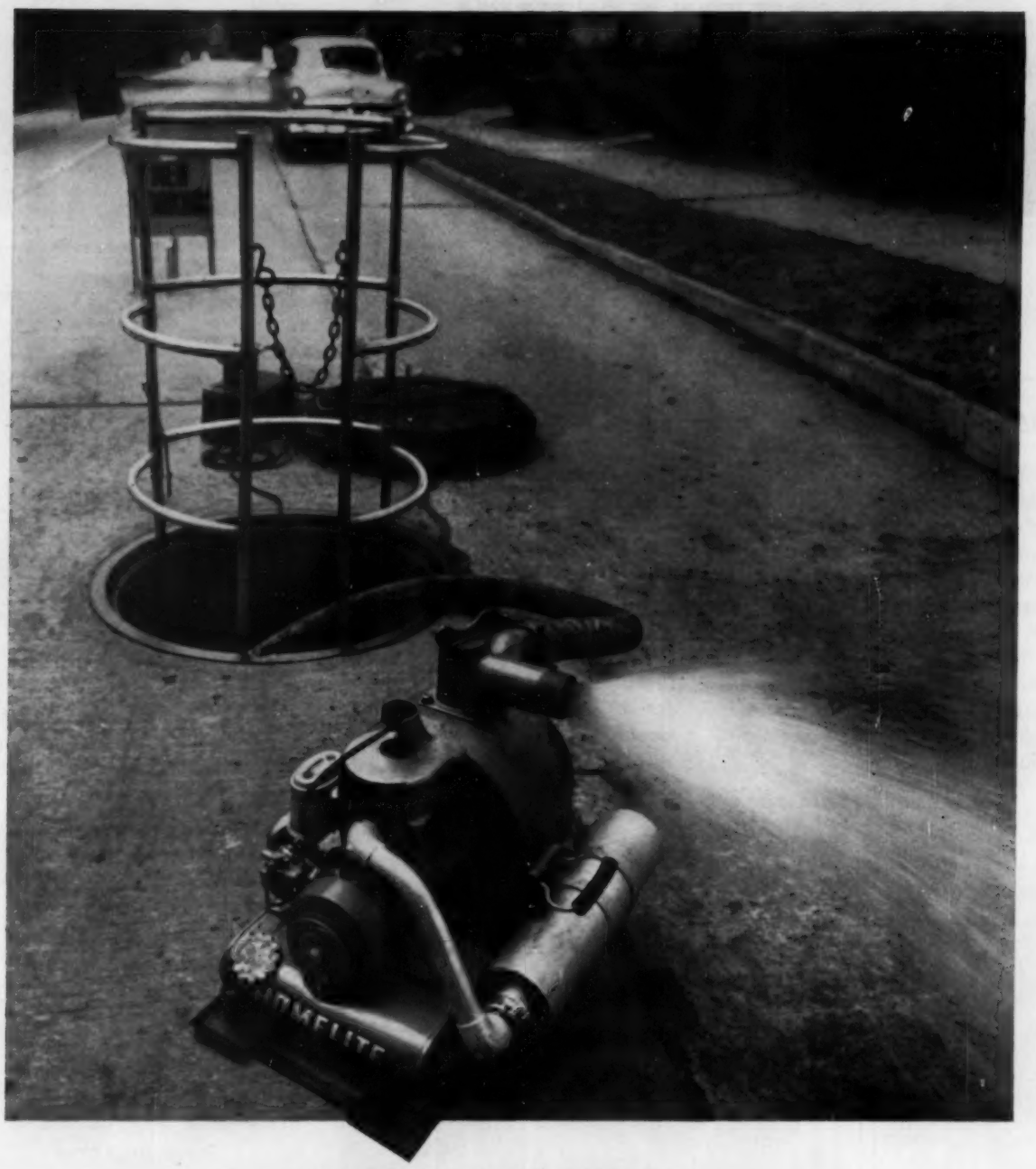
But there's no guessing where the fabrication of these joint rings is concerned. Every ring used in the making of Lock Joint's flexible, self-centering and completely watertight Rubber and Steel Joint is carefully cut, rolled and welded. Then, to assure absolute roundness and exact diameter, every ring is sized on an hydraulic press to such close tolerances that any spigot ring will fit perfectly within any bell ring of like nominal diameter. This is only one of the many quality control measures which go into every phase of the manufacture of LOCK JOINT CONCRETE PRESSURE PIPE, to assure to the customer the highest type pressure pipe obtainable.

LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous



New HOMELITE Pump

Whispers While It Works

Goodby residential complaints! Here's a new lightweight gasoline engine driven pump that takes it easy on the neighbors' ears. Yet handles any water problem . . . from seepage to volumn pumping! The new Homelite Model 36 S2 2″ self priming centrifugal Pump operates at slow speed with low noise level yet has high capacity of 9000 gallons per hour. It weighs only 85 pounds and can be easily carried by one man to the best pumping location. Starts quickly, primes automatically, gives long, dependable and trouble-free service under the toughest conditions. Ask your Homelite Representative for a free demonstration. You'll find a good neighbor policy in every pump.

HOMELITE

a division of Textron Inc.

705 RIVERDALE AVENUE • PORT CHESTER, N. Y.

PERMUTIT® presents the

VALVELESS FILTER

Completely Automatic Gravity Filter Costs Less than Manual Unit

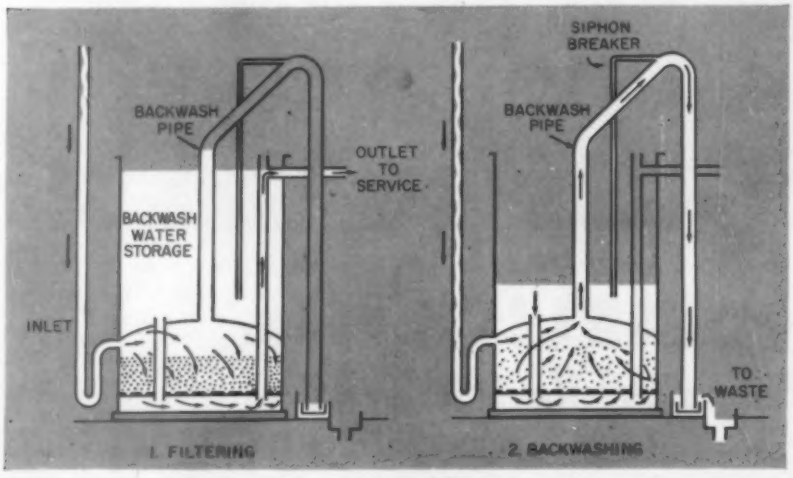
Uses no valves, no pumps, no flow controllers

Here's an entirely new concept in water filters for cities, factories and power stations: a filter that *eliminates* operation and maintenance expense . . . yet costs *less* than a conventional manually-operated gravity filter of the same size.

The Permutit Valveless Filter can be used wherever gravity flow is feasible. Units are now in operation providing both plant process and drinking water.

FOOLPROOF OPERATION

The Valveless Filter thinks for itself. It starts backwashing at a predetermined head loss, rinses and returns to service automatically . . . and as efficiently as an expertly operated manual filter. It assures uniform, high quality effluent because it eliminates "human error." It cannot be forced. It cannot backwash or rinse too soon or too late, too fast or too slow, too much or too little. It cannot develop a negative head and thus eliminates the chief cause of mudballs, channelling, upset beds. The absence of gravel eliminates another cause of upset beds. Backwash or rinse water cannot be accidentally run to service.



HOW IT WORKS

Filtering. Water enters at left, flows through sand, strainers and false bottom up effluent duct to service. As head loss increases during run, water rises in backwash pipe. At maximum headloss, water spills into downward section of backwash pipe and starts backwash (siphon) action.

Backwashing. Siphon draws water from storage down through ducts, up through strainers and sand to expand and wash bed, then to waste. At low storage level, air enters siphon breaker to stop backwash. Flow reverses and filtered (rinse) water flows into storage until full. All flow then goes to service.

PROVEN PERFORMANCE

Photo shows two Valveless Filters in a large industrial plant. (Shut-off valve at left is used only to take front filter out of service.)

LOW INSTALLATION AND EXPANSION COST

Filters up to 10 ft. diameter are shipped set up. Piping is simple. Future filters are easy to add since they require no additional backwash water storage or pump capacity. Filters use minimum floor space.

FREE BULLETIN

New bulletin, "The Permutit Valveless Filter," includes details, drawings, operating conditions, capacities. Address: The Permutit Company, Dept. W-5, 330 West 42nd St., New York 36, N. Y. or Permutit Company of Canada Ltd., Toronto 1, Ont.

PERMUTIT®

rhymes with "compute it"

Water Conditioning
Ion Exchange • Industrial Waste Treatment

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

Vol. 104 No. 5

MAY 1957

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CONTENTS

New Operations Center for Indianapolis Water Company 179
by Lewis S. Finch and Gerald S. Lyons

Notes on Water Works Laws 191
by John H. Murdoch, Jr.

Flow in Rectangular Channels 198
by L. E. Livingston, Jr.

Factors Influencing Per Capita Water Consumption 199
by Ralph Porges

How to Increase Revenue Without Raising Water Rates 205
by Raymond F. Bishop

Caracas, Venezuela—New Water Supply from Rio Tuy 207
by Ing. Andre's Marcano-Coello

Corrosion—Part I 210
by George E. Symons, Ph. D.

Ten Years Operation and Development at Luton Sewage Treatment Works 214
by S. C. Evans

Use of Outside Forces Cuts Sewer Cleaning Costs 220
by George Orland

Louisville Sewage Facilities Under Construction 223
by La Rue Spiker

Sludge Disposal—Series 2, Part 9 226
by Don E. Bloodgood

Meetings Scheduled 106A

New Equipment 116A

Manufacturers' News 133A

Literature and Catalogs 138A

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The Fairbanks-Morse advertisement at the right appeared in the above publications, having a combined circulation of 6,095,761.

To help them realize . . .

City officials and engineers are acutely aware that inadequate water facilities will strangle a community's future.

Unfortunately, too many citizens and voters still do not realize how critical, how pressing their need is for increased facilities *now*.

That is why the penetrating message at the right is appearing before the eyes of millions of readers in The Saturday Evening Post, in U.S. News & World Report and The Wall Street Journal. That is why you will see more messages like this throughout the year . . . and why the timely booklet "Your 1100 Gallons" is going to communities throughout the nation.

In the final analysis, the voters in your community will base their decisions on your knowledge and recommendations. Let us work with you to help them realize the urgency.

City officials are already requesting these booklets to give to leading citizens. Write today for your copy. Fairbanks, Morse & Co., Dept. WSW-5, 600 South Michigan Ave., Chicago 5, Ill.

Large blow-ups of this ad in color are now available. Write for yours.

"No sprinkling until further notice".

(Did this happen to you last year?)

Stringent restrictions on water are becoming more common each year. America's water needs have far outstripped our water supply facilities. Too many of our water works, our pumping stations, our wells, are antiquated when faced with our booming birth rate—our expanding economy and industry—our vastly increased water consumption.

Industry consumes 81 billion gallons a day. Agriculture demands 105 billion more gallons daily. In the home, every man, woman and child averages 50 gallons a day—with a population of 170,000,000 and a new citizen being born every 8 seconds!

Add up the Gargantuan thirst our nation has for water, and you see why our water systems aren't equal to the need. Everyone's using more. What can you do about it? Work actively with your local water authorities on planning now for adequate water facilities. Support bond issues for water works expansion or modernization. Your help is needed—now!

Interested citizens and city officials are invited to write Fairbanks, Morse & Co., 600 South Michigan Avenue, Chicago 5, Illinois, for a copy of "Your 1100 Gallons," a timely article on water shortage problems.

PUMPS FOR	
☒	MUNICIPAL SERVICE
☒	INDUSTRY
☒	HOME
☒	AGRICULTURE

Fairbanks-Morse, the biggest name in pumps, supplies pumps and power for every water need.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS

Dependability is the

Pipe, like chain, must be strong in *all* elements.

Listed below are five factors of strength that have enabled cast iron pipe to achieve a record of dependability and long life unmatched by any other.

44 North American cities are still being served by cast iron water mains laid a century or more ago. Hundreds of others have passed the 50 year mark.

Impressive as this record is, today's *modernized* cast iron pipe is even more efficient. Tougher, stronger, more durable. You can stake your reputation on cast iron pipe.

The record proves it!

DEPENDABILITY IS BASED ON STRENGTH— STRENGTH IS BASED ON THESE 5 FACTORS

1. **CRUSHING STRENGTH*. . .** Standard 6″ Class 150 cast iron pipe will withstand a crushing load, under standard tests, of 17,900 pounds per foot. . . important where heavy fill or unusually heavy traffic loads must be overcome.

2. **BEAM STRENGTH*. . .** Settlement or disturbance of the soil by other utilities or resting on an obstruction places a heavy strain on pipe. 6″ class 150 pipe bears up under a load of 20,790 pounds and deflects 2.32 inches.

3. **BURSTING STRENGTH*. . .** The average of many tests prove that standard 6″ class 150 cast iron pipe will not burst until subjected to internal pressure of 3000 pounds psi . . . ample to resist water hammer or unusual working pressures.

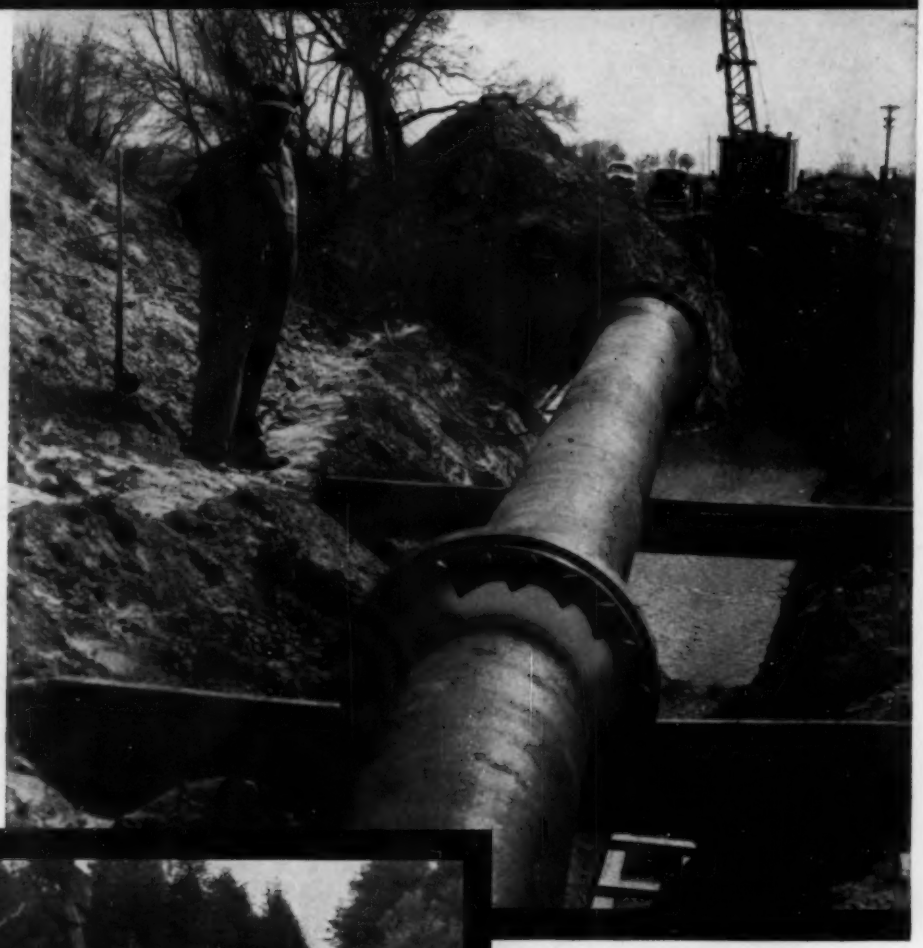
4. **JOINT STRENGTH . . .** A full range of leak-proof, low cost, easy-to-assemble joints and fittings are available to meet all conditions.

5. **CORROSION RESISTANCE . . .** Cast Iron Pipe resists corrosion effectively . . . vital factor in its demonstrated long life and dependability.

*Based on independent laboratory tests.

CAST IRON PIPE

sum of many parts . . .



River crossing installation of 16" flexible joint cast iron pipe at Salina, Kansas.

Greensboro, N. C.— Installing dual water lines with new 30" Mechanical Joint cast iron pipe, plus salvaged 24" Bell-and-Spigot cast iron raw water line in service approximately 25 years.

CAST IRON

Cast Iron Pipe Research Association
Thos. F. Wolfe, Managing Director,
Suite 3440, Prudential Plaza, Chicago 1, Ill.

SERVES FOR CENTURIES...

P.F.T.

NEW DEVELOPMENTS IN SEWAGE TREATMENT

New P.F.T. plate holders are installed quickly, without special tools.

Totally new aeration plate holders improve any activated sludge process

P.F.T. announces the first major advance in fine media diffusers in 10 years—new circular holders with carborundum plates.

Plates are quickly installed or replaced by hand. A single bolt and wing nut holds the entire assembly securely in place. Provides a positive seal against air leakage around plates.

The new P.F.T. circular plate holders are made from a special non-hydroscopic asbestos and asphalt compound. This inert material is not affected by alkaline or acid often present in sewage. Ends rust and locking problems.

At the option of the designing engineer, the air diffusion assemblies may be arranged for servicing without dewatering or removing the aeration tanks from service.

In the P.F.T.-Kraus Dual Aeration System, operating with the P.F.T. orifice-valve for distributed air, and the P.F.T.-Kraus Interchange process, these holders provide the most economical and efficient activated sludge process available today. They can also be used to advantage in *any* aeration system using air from blowers. Write today for application details to fit your design, or for the technical study, *Dual Aeration as a Rugged Activated Sludge Process*, by L. S. Kraus.

waste treatment equipment exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE DENVER

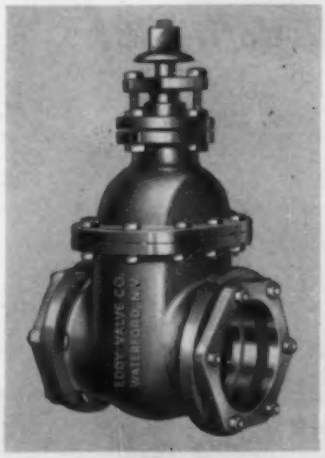
OUT THEY GO!

and IN go EDDY HYDRANTS

Many of the 650 fire hydrants in Maywood, Illinois (pop. 30,000), have been in service 40 years or longer. Some were no longer being manufactured, and repair parts were unavailable. In a decision to modernize its hydrants, Maywood decided to standardize on Eddy hydrants in 1954—to simplify servicing, cut maintenance costs, reduce parts inventory, and assure service for the future.

Eddy hydrants had proved highly satisfactory in Maywood's 50-mile system, and repair parts have always been available. Under the aggressive direction of public works director Bazel E. Crowe, above left, the replacement program, has proceeded at a fast, economical rate, with more than 170 hydrants replaced in 1956 alone.

it's the safest, most economical course!



EDDY
AWWA (UNDERGROUND) VALVES

Everything in AWWA valves for underground use in your waterworks system is quickly available from Eddy—gate valves; cutting-in valves and sleeves; tapping valves and sleeves. And, remember, Eddy's more than 100 years' dependable operation is your assurance of service far into the future.

Maywood feels that it cannot risk hydrant failure, nor afford the sky-high cost of handmaking individual repair parts for obsolete, "orphan" fire hydrants. Can you?

Based on the experience of this and other alert communities, your city or village might do well to take stock of its hydrant situation. If so, an EDDY man will be very glad to give facts and figures you will find most helpful in making a wise decision. Won't you invite him to see you . . . soon?

AWWA EDDY BRONZE-MOUNTED HYDRANTS

EDDY Bronze-Mounted HYDRANTS open smoothly with the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below hydrant valve means that there is no water loss due to a bent stem.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.
WATERFORD NEW YORK

'Red Water' doesn't live here any more!

No more 'Red Water'—thanks to Threshold Treatment with Calgon*—that's the record in this typical community.

When Calgon treatment was started, 'Red Water' stopped, and now everyone is complimenting the water superintendent.

Calgon in very small amounts is effective against 'Red Water' because it not only stabilizes iron and manganese dissolved in water at its source, but it also prevents iron pickup from pipes.

Calgon stops lime scale, too, by forcing calcium carbonate and other scale-forming chemicals to stay in solution, even when the water is heated. Calgon is used in minute amounts, and the reduction of lime scale means important savings in keeping equipment and meters clean.

Call on Calgon for the economical solution to your specific problem. Many years of experience with water problems of all kinds in every part of the country are at your service.

*Calgon is the Registered Trade Mark of Calgon, Inc. for its glassy phosphate (sodium hexametaphosphate) products.

CALGON COMPANY

A DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES

How this hydrant

PAYS A BONUS!

It's unique... it's the B-50-B

EVERY new installation of Darling B-50-B A.W.W.A. Hydrants . . . proves the advantages this new hydrant offers you.

Darling's ball bearing design cuts required operating torque more than 50%—an important factor in *any* system. Action is easy, smooth and sure!

Darling "O" ring seals provide a *dry-top, packless* hydrant, minimizing service and maintenance needs and eliminating the hazard of water reaching the operating threads.

This operating surety and low-cost performance of Darling B-50-B hydrants are bonus values that just can't be matched. You can get the B-50-B design in a wide range of Darling hydrant types to meet your particular installation requirements.

Send for Bulletin 5403

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by
The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ontario.

Palatable Water Means Good Public Relations

The severest critic of the palatability of a water supply can be the casual visitor—tourist or salesman, because he can compare your supply with that of other communities. Ill-tasting water can also influence industries against settling in your town. Every water works official should strive to satisfy the severest critic, thereby pleasing the local consumers as well. Adequate usage of Nuchar activated carbon will assure delivery of a palatable water at all times, so that when your local consumers go travelling, they will return with that wonderful feeling—"There's no place like home."

AQUA NUCHAR ACTIVATED CARBON'S adsorptive ability covers a wide range of taste- and odor-producing bodies. John R. Baylis has stated "All tastes and odors likely to be present in a water supply can be removed with activated carbon. We find a few statements in the literature on water treatment that the taste or odor was not removed by the addition of carbon, but almost invariably the reason was that not enough carbon was used.

GOOD CARBON · GOOD WATER · GOOD WILL

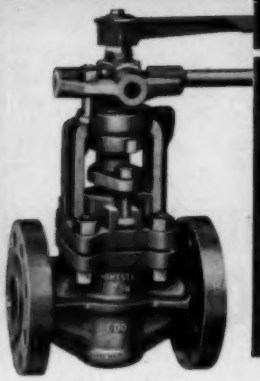
New York Central Building
230 Park Ave., New York 17, N.Y.
Phila. Nat'l Bank Bldg.
Broad & Chestnut Sts., Phila. 7, Pa.

industrial CHEMICAL SALES
division west virginia pulp and paper company

Pure Oil Building
35 E. Wacker Drive, Chicago 1, Ill.
2775 S. Moreland Boulevard
Cleveland 20, Ohio

if your problem is...

- TEMPERATURE
- PRESSURE
- CORROSION...



HOMESTEAD *Lever-Seald* **PLUG VALVES** *will solve it...*

Conditions which cause ordinary valves to fail --corrosive, erosive, viscous, or volatile hard-to-hold fluids, plus temperature or pressure extremes --are everyday jobs for Homestead Lever-Seald Valves. Why? Because they *are built to operate under all conditions!* They never stick!

Every Homestead Lever-Seald Plug Valve has a powerful lever and screw device that does double duty. It presses the tapered plug firmly into its seat to form a drop-tight seal, and also provides a positive means to relieve seating pressure and permit easy operation.

Lever-Seald Homestead Valves give extra long, leak-proof service, too, because all operating parts and seating surfaces are protected from line fluids in both the open and closed positions. You can prove their economy to your own satisfaction, by making your next replacement a Homestead Lever-Seald.

Your choice can be made from valves cast of metals and alloys to specification in sizes from 1″ to 12″; for pressures from vacuum to 1500 pounds; temperatures from 40° below zero to 1100°F. Dry seat or pressure gun lubricated optional.

You'll find our VALVE REFERENCE BOOK No. 39-3 interesting and helpful. It's yours for the asking.

MAIL THE COUPON TODAY!

Without obligation, send me Valve Reference Book No. 39-3 describing Homestead Lever-Seald Plug Valves.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. BOX 42 "Serving Since 1892" CORAOPOLIS, PA.

SIX MILLION GALLONS of water per day are delivered to City of Colorado Springs by three Worthington 400-hp centrifugal pumps, like that in foreground, at Lake George Pumping station. A 200-hp engine-driven Worthington is on standby service. This installation was engineered by Black and Veatch Co. of Kansas City, Mo.

15 Worthington pumps supply water to fast-growing Colorado Springs

THREE 300-HP WORTHINGTON vertical turbine pumps move well water from common sump to Colorado Springs' Fort Carson supply line.

A population up 50% in 10 years, an expanding industry, the new Air Force Academy—all these have spurred the demand for water in the City of Colorado Springs.

The job of supplying the city with an additional 6 million gallons of water a day falls to the Worthington-equipped Lake George and Secondary Pumping stations. Together, these stations pump water through a total pipeline distance of 92,810 feet with a lift of 1,580 vertical feet. Each station contains three 400-hp Worthington centrifugal pumps each of 2-mgd capacity. A 200-hp gasoline-engine-driven pump on standby service in each station provides minimum flow in case of power failure to prevent possible freezing of the lines.

Colorado Springs also obtains water from Fountain Creek Valley. This water is pumped to a common sump by four 30-hp pumps and from the sump to the distribution system by three 300-hp pumps—all seven pumps being Worthington vertical turbines.

The Colorado Springs water works installation is typical of thousands using rugged, reliable Worthington public works equipment—pumps, engines, compressors, turbines. Worthington engineers will be glad to help you apply this equipment to *your* water works or sewage needs. Write Worthington Corporation, Public Works Division, Harrison, N. J.

W. & S.

WORTHINGTON

ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY

Water Works Pumps • Sewage Pumps • Comminutors • Vertical Turbine Pumps • Vacuum Pumps

The most efficient main line metering device, the Venturi Tube, has undergone design modifications and standardization to become an even better differential producer. Years of exhaustive tests on head loss, coefficient, recovery angles, and effects of upstream piping . . . conducted in the research laboratory at Builders-Providence . . . have produced 130 standardized constructions designed to give "tailor-made" service to a wider number of applications *more economically*.

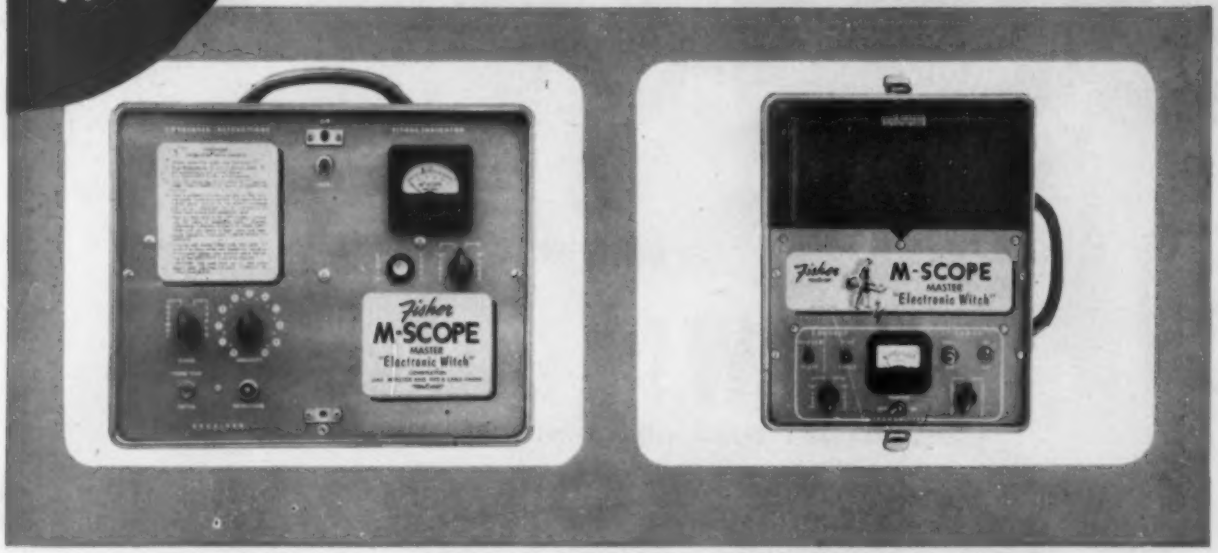
Each construction is available in (1) a wide variety of construction materials, (2) a choice of end designs (flange, bell and spigot, Victaulic or Dresser type couplings, etc.), and (3) with numerous allied accessories. If you have a main line metering problem, we have the answer!

New Bulletin 110-N1 gives complete data on both Builders short form and Hershel Standard Venturi Tubes. Write to . . . **Builders-Providence, Inc., 350 Harris Ave., Providence 1, R. I.**

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
B·I·F METERS, FEEDERS, CONTROLS

New!

TIME-$AVING COMBINATION LEAK DETECTOR-PIPE LOCATOR



THE M-SCOPE MASTER Electronic Witch Combination

You're looking at the much-talked-about **NEW** M-Scope . . . the only dual-purpose that detects leaks **and** locates pipe. Its rugged, highly efficient electronic circuit, plus ease of use and portability, make this instrument one of the most welcome contributions to the water works industry.

Quick Facts

LOCATING A LEAK AT THE VALVE

FINDING A LEAK UNDER PAVEMENT

ONE MAN OPERATION

LOCATING A SERVICE

For greatest convenience and reliability, the M-Scope MASTER is equipped with a **built-in battery tester** for instant checking of battery condition in the field or elsewhere.

WRITE TODAY FOR SPECIFICATIONS AND PRICE!

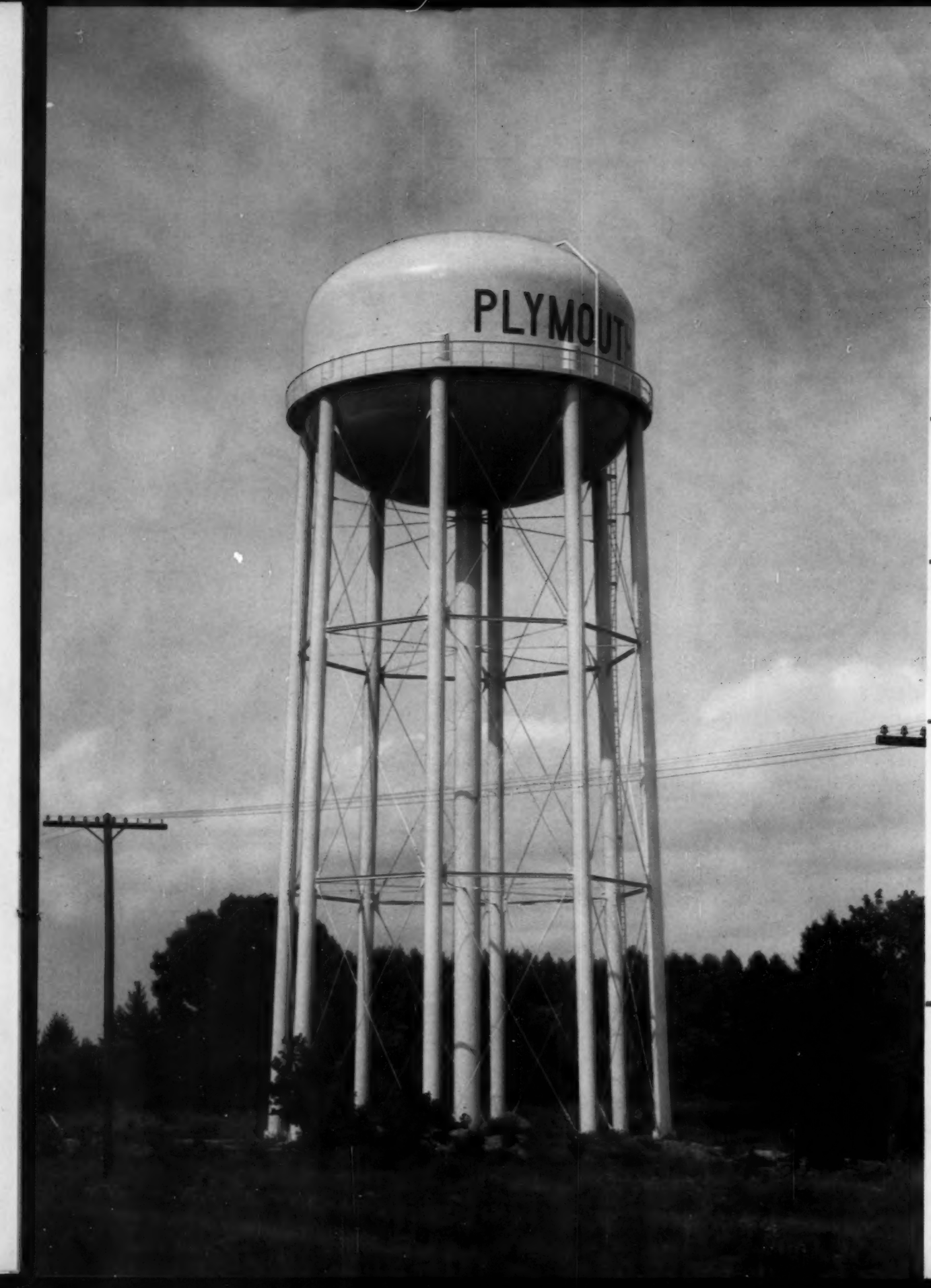
PIPE LINE EQUIPMENT
JOSEPH G. POLLARD CO., INC.
PIPE LINE EQUIPMENT
PIPE LINE EQUIPMENT

Place your next order with POLLARD

If it's from POLLARD . . . It's the Best in Pipe Line Equipment

NEW HYDE PARK • NEW YORK

Branch Offices: 964 Peoples Gas Building, Chicago, Illinois
333 Candler Building, Atlanta, Georgia



FILE REFERENCE

FACT SHEET

GRAVER®

Elevated Water Tank for the City of Plymouth, Indiana

Ralph Lentz, Water Works Superintendent
Clyde E. Williams & Associates, Inc.,
Consulting Engineers, South Bend and Indianapolis, Ind. and Lansing Mich.
Lloyd Taylor, Project Engineer
Graver Tank & Mfg. Co., Inc.,
Design, Fabrication and Erection

Type: Double Ellipsoidal Elevated Tank
Capacity: 400,000 gallons
Height of Overflow: 130 feet
Low Water Level: 100 feet
Diameter of Tank: 50 feet
Built to AWWA Specifications, except that ¼" plate was used on the roof instead of ⅜" minimum
Painted and Sterilized

THE PROBLEM

A water supply system designed to serve a rural county seat of 3,838 people was woefully inadequate for today's population of 6,704 in this thriving trading center. One industry alone consumed one-third of the water. And the situation was further complicated by a disasterous flood in 1954 which polluted the city's wells located near the Yellow River. Steps had to be taken without delay to meet the problem.

THE SOLUTION

Anticipating probable population and commercial requirements by 1980, plans were developed for new wells, larger mains, and adequate pumping and storage capacity. Standards of the National Board of Fire Underwriters indicated a fire pumping formula of 150% of the flow required for normal domestic use, plus 10 hours of fire flow. The desirable storage capacity was set at 500,000 gallons, 100,000 gallons in an existing tank and 400,000 gallons in a new tank.

Graver was selected to design, fabricate, erect, paint and sterilize the new 400,000 gallon elevated water tank.

The close teamwork of the city's water works superintendent, the consulting engineers and the Graver organization speeded the elevated water tank erection so that the new water system could be put into operation in 1956.

If you have a water storage or pressure problem, it would be well to talk it over with a qualified consulting engineering firm and Graver, whose 100 years of experience in tank fabrication and erection can contribute measurably to your plans.

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

New York • Philadelphia • Edge Moor, Delaware
Pittsburgh • Detroit • Chicago • Tulsa • Sand Springs, Oklahoma • Houston • Los Angeles
San Francisco • Fontana, California

A CENTURY OF CRAFTSMANSHIP IN STEELS AND ALLOYS

GRAVER®

DESIGNED, FABRICATED AND ERECTED BY

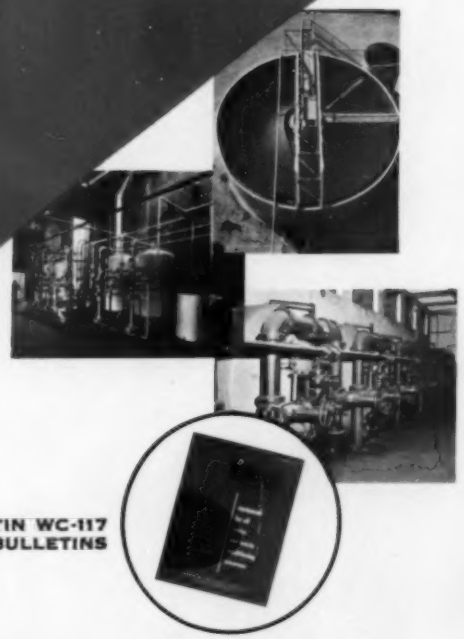
Water Treatment Specialists

FOR FIFTY YEARS

GRAVER®

Water and Industrial Waste Treatment
Equipment to meet all requirements

High Rate Softeners and Clarifiers
Sedimentation and Settling Basins
Flocculators • Filters • Zeolite Softeners
Flotation Units • Ion Exchange Systems
Flash Mixers • Coagulators



WRITE FOR GENERAL BULLETIN WC-117
AND SPECIFIC BULLETINS

Dept: WS

GRAVER®
GRAVER WATER CONDITIONING CO.
Division of Graver Tank & Mfg. Co., Inc.
216 West 14th Street, New York 11, N. Y.

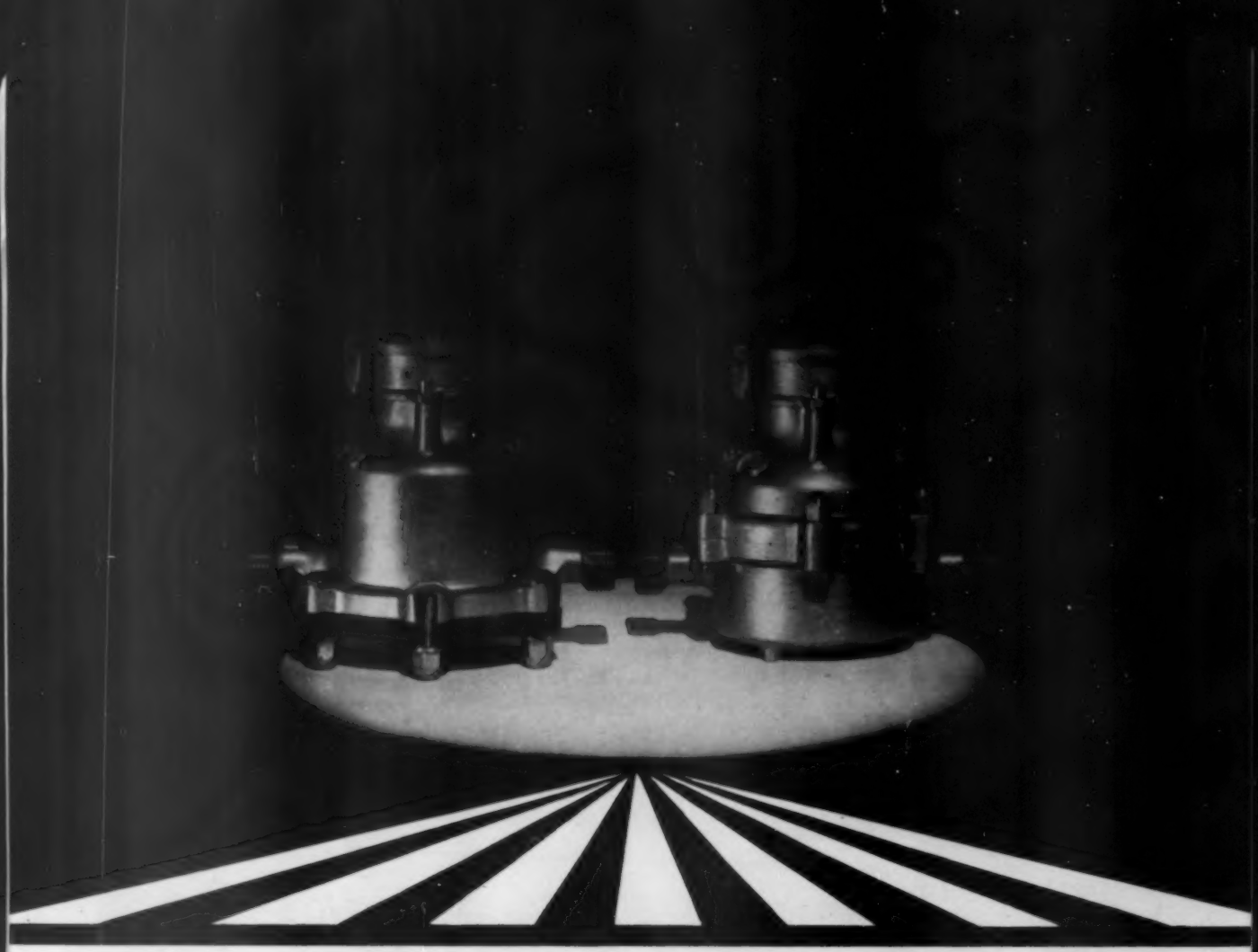
An Invitation

TO VIEW A REVOLUTIONARY NEW PRODUCT BY ROCKWELL

You are cordially invited to attend the first public showing and demonstration of a remarkable new product development designed by Rockwell to materially increase the operating efficiencies and earnings of all water works properties.

THE OCCASION: A.W.W.A. Convention,
May 12-17, 1957

THE PLACE: Booths 418 to 523,
Convention Hall



HERSEY

A name that has been preëminent in the Water Works field for 72 years

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

75 Years of Progress

A world-wide organization ready to serve you

In May, 1882, Mahlon B. Layne drilled his first water well, thus beginning an organization that would become world-wide and world-famous. He designed the Layne Vertical Turbine Pump, Layne Shutter Screen and Layne Gravel Wall Well. These are recognized today for their combined unfailing performance in producing water for this world.

Layne has always accepted the challenge of leadership. Engineering advances and research have guided our organization from the beginning. This is the pattern which has earned Layne the reputation for world-wide leadership. We owe this leadership to the trust our valued customers have placed in our organization.

Call on your nearest Layne Associate Company

DOMESTIC

LAYNE-ARKANSAS COMPANY
Stuttgart, Arkansas
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Lake Charles, Louisiana
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LAYNE-MINNESOTA COMPANY
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LAYNE-NEW YORK COMPANY
Linden, New Jersey
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Mishawaka, Indiana
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LAYNE TEXAS COMPANY, INC.
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FOREIGN

INTERNATIONAL WATER SUPPLY, Ltd., London, Ontario, Canada
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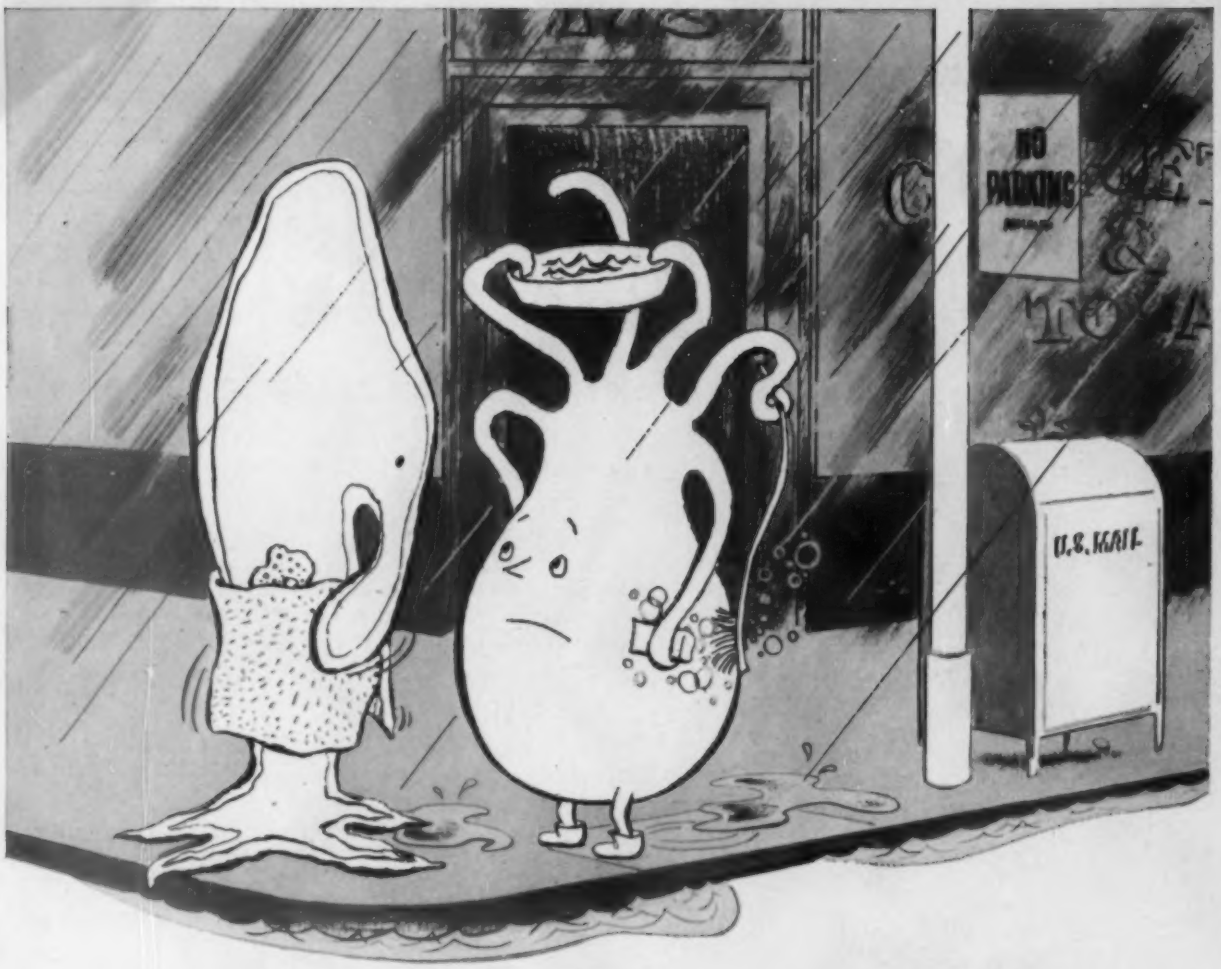
1882 — 1957
Layne
75 YEARS OF PROGRESS

LAYNE & BOWLER, INC. MEMPHIS

General Offices and Factory • Memphis 8, Tennessee

WATER WELLS • VERTICAL TURBINE PUMPS • WATER TREATMENT



"Only way to get a bath, Orgie, since they started treating their water with **PITTCHLOR**®!"

How true, Algie. Water, water everywhere . . . but far too much of it treated with Pittchlor. Take that inviting water works and sewage disposal plant . . . its water has been kept free from the likes of you for a long, long time. No wonder plant operators swear by Pittchlor for their hypochlorination treatments.

Pittchlor is extremely effective in its destruction of chlorine-susceptible bacteria and algae. This high test calcium hypochlorite contains 70% minimum available chlorine, and has the stability to release this content over prolonged periods. And Pittchlor's ready solubility means less sediment to clean out.

In many instances, Pittchlor aids in the formation of a proper floc. It's useful in controlling slime and odor, and is the perfect source for emergency chlorine.

Pittchlor's convenient to use, too! Its dry, free-flowing granular form permits ease of application, either manually or by mechanical feeders. For more information, send for free folder.

PITTCHLOR available in 5 lb. (9 per case) and 2½ lb. (6 per case) resealable cans —and 100 lb. drums

Stocked by leading jobbers everywhere

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte Chicago • Cleveland • Boston • New York • St. Louis • Minneapolis • New Orleans • Philadelphia • Houston Pittsburgh • Dallas • San Francisco
IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

FOR THE BEST IN *Water Meters*

go ALL AMERICAN

AMERICAN METERS *Have Longer Life*

Many American Meters in operation for 30, 35 years or more are still giving dependable accurate service. American Meters built today are so greatly improved that we know their period of service will be even longer. How much longer is difficult to estimate. It will depend entirely on the chemistry and the pH of the water to be measured and whether or not the metallurgy of the meter components has been tailored to meet the requirements.

Give Buffalo Meter Engineers full data on your water conditions and meters will be specified that will give longer life when you "go all American."

BUFFALO METER CO.
2909 MAIN STREET BUFFALO 14, NEW YORK

Diatomite filters with ALOXITE® tubes give low-cost, dependable swimming pool filtration

Built by Proportioneers, Inc., Division of B.I.F. Industries, Inc., the diatomite filters shown at right effectively filter swimming pool water season after season . . . without excessive maintenance.

Contributing to their successful, economical operation are the Aloxite® aluminum oxide porous tubes or septa that support the diatomite. These have many inherent advantages. For example, pore area is a high percentage of their total area. Pre-coat builds up uniformly. Backwash is uniform and effective. The Aloxite® septa are fine enough to give partially effective filtration without the diatomite in periods of emergency. And they resist acids — which permits cleaning of units clogged by iron and other materials.

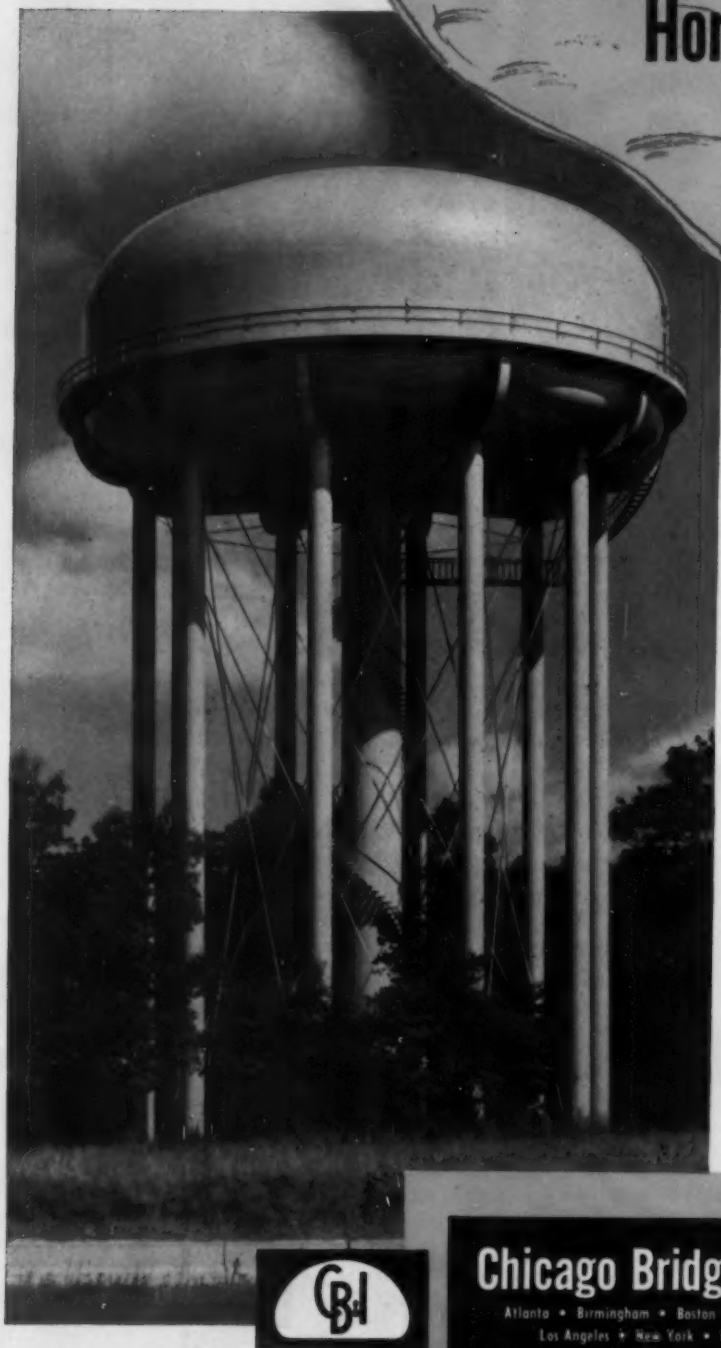
This informative 56 page booklet covers porous media for all fields of filtration and diffusion. Write us for your free copy today.

CARBORUNDUM
Registered Trade Mark

Dept. U31 Refractories Division
Perth Amboy, New Jersey

A Million Gallon Horton Tank

in the heart of tobacco land



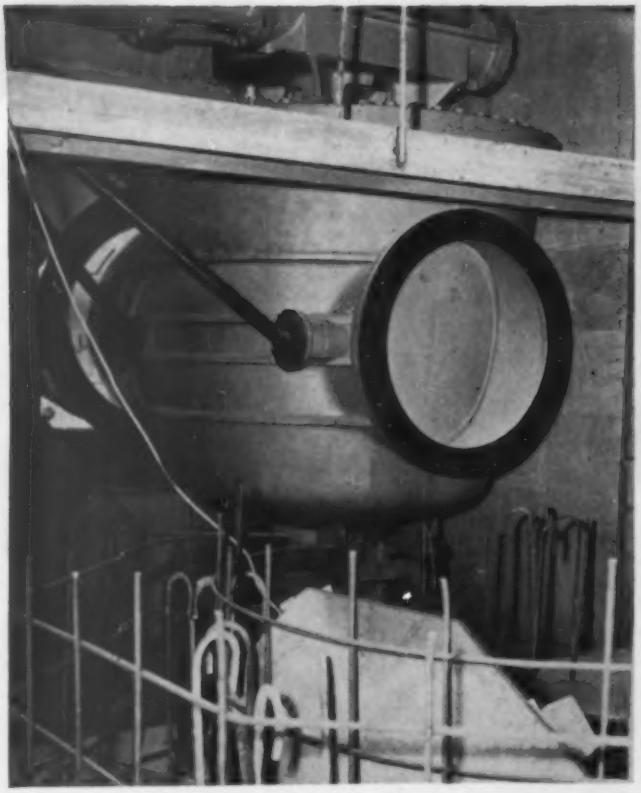
Winston Salem, North Carolina, located in a region noted for tobacco growing and reported to turn out more manufactured tobacco products than any other city in the world, has a 1,000,000-gal. Horton® radial-cone elevated tank helping provide an efficient municipal water system. Storing water that will flow by dependable gravity pressure when needed, the Horton elevated tank helps increase minimum distribution pressure and decrease pressure variations during peak load periods.

Horton elevated tanks are built in standard sizes to 3,000,000 gallons. To find out the benefits such a tank can provide for your city, write the nearest Chicago Bridge & Iron Company office.

1,000,000-gallon Horton radial-cone tank at Winston Salem, N. C., with a range in head of 30 feet.

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa • Washington
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.



▲ Downhill view from Iron Mountain tunnel inlet shows first two conduits and pumping station, with reservoir and aqueduct in background. Excavation at right of pumping station will house third set of pumps, and third conduit will be added.

◀ This SMS-Rotovalve at Iron Mountain shows clearly the drop-tight shut-off position. In operation, the conical plug first lifts, then turns, finally reseats, giving you precise aperture control.

3 MORE SMS-ROTOVALVES ORDERED FOR PUMP DISCHARGE SERVICE AT IRON MOUNTAIN

As part of the expansion program for increasing the supply of water to southern California through the Colorado River aqueduct, three more SMS-Rotovalves have been ordered by the Metropolitan Water District of Southern California. These three 48″ x 64¼″ tapered Rotovalves, duplicates of six already installed at Iron Mountain Pumping Station, will be used for pump discharge service. Their inherent characteristics of a large reduction of flow area during the early part of the closing stroke make them ideally suited to control of surges in the event of emergency shut-off.

SMS-Rotovalves give the least possible pressure loss. In the open position, their full line opening offers no more resistance than a straight piece of pipe of the same diameter. Hydraulic unbalance and mechanical design make operation easy, and less powerful operators may be used. Rotovalves' flexibility suits them to any type of operation, any method of control, or any sort of location.

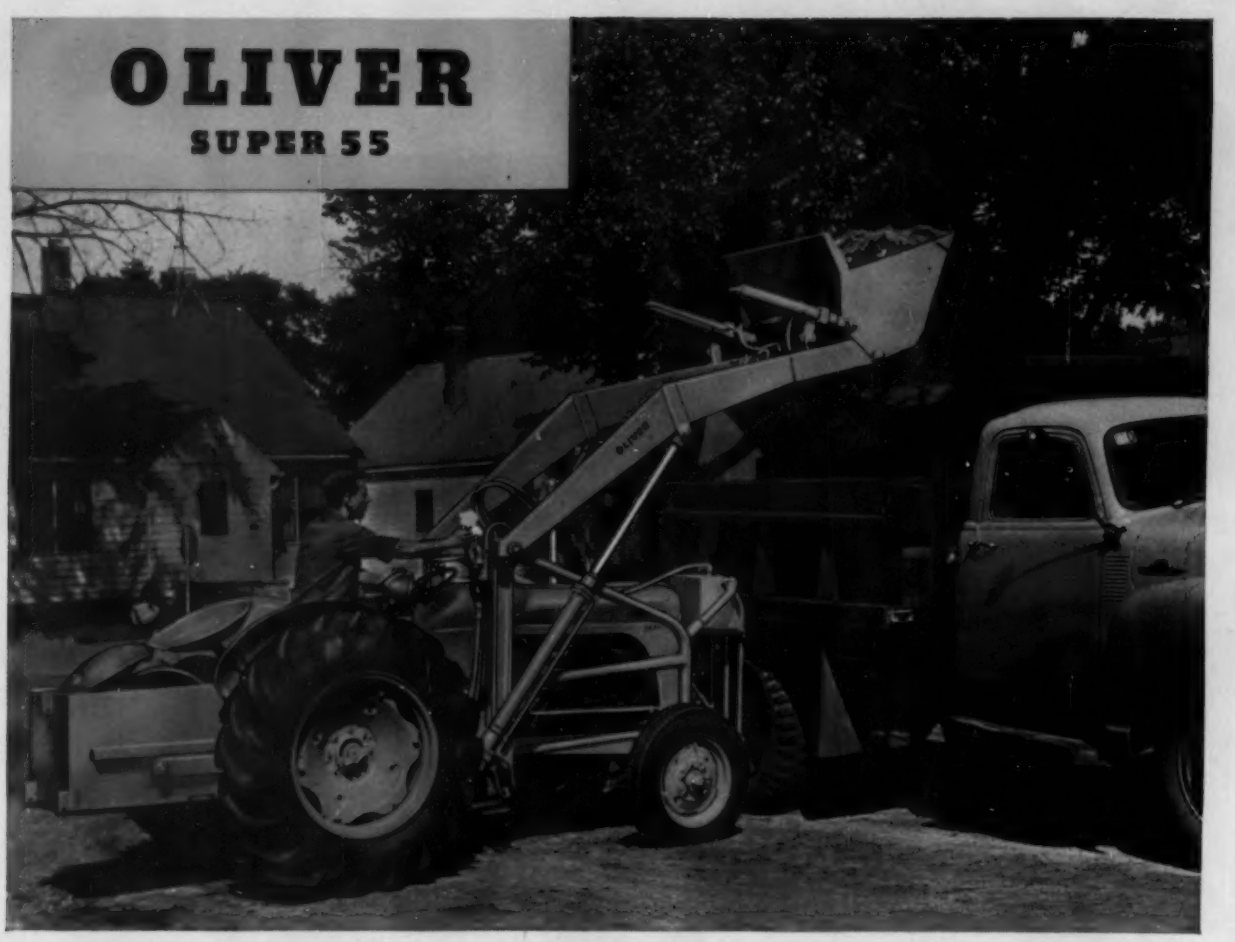
To obtain information on SMS-Rotovalves, as well as on the entire SMS line of Butterfly and Ball Valves, contact our nearest representative, or write S. Morgan Smith Company, York, Pennsylvania.

S. MORGAN SMITH — HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

2

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories



Save money all over town

with the new 58 Loader...and Jet-Trencher

This versatile Super 55 is an outstanding money saver on all kinds of municipal work such as digging, dozing, loading, grading and cleanup assignments.

Now, with the new 58 Loader it's a better buy than ever before. Big 11-cu. ft. bucket has full roll-back action and 3800-lb. breakaway power for bigger production and full loads at every pass. New higher clearance of 10′ 10″ makes truck-loading easier and faster. Full hydraulic operation is so simple the average operator becomes expert in a matter of hours.

You'll keep the Super 55 busy the year 'round on street and service line work, handling stock pile materials, snow removal and scores of other jobs. Full range of attachments includes dozer blade, scraper, scoop, fork lift, mowers, wood saw and a dozen more.

See your Oliver construction machinery distributor for full details. Or write us for literature.

With JET-TRENCHER the Super 55 becomes a double-ended money saver. Its fast-working ⅜-yd. bucket digs up to 11 ft. deep, dumps to either side with a full 180° swing. Hydraulic operation is smooth, powerful, safe. With simple 2-point hitch, the Jet-Trencher can be attached or removed in only 3 minutes.

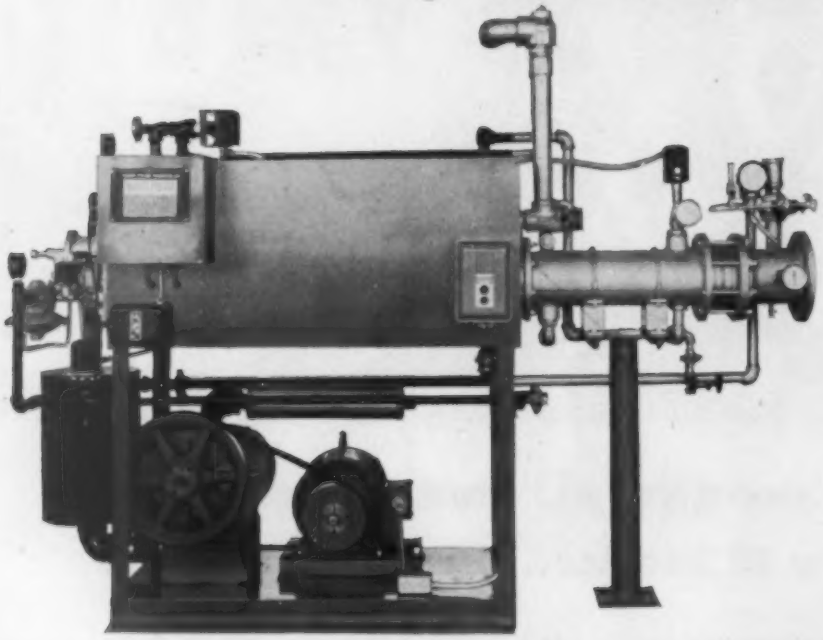
THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

A COMPLETE LINE OF INDUSTRIAL WHEEL AND CRAWLER TRACTORS AND MATCHED ALLIED EQUIPMENT

50% MORE CO_2

for your recarbonation basin



with the

WALKER PROCESS Carball CO_2 unit

The specially designed CARBALL burners, using gas or oil, produce up to 50% more CO_2 per unit of fuel. Complete combustion of the fuel and air mixture is attained by 100% burner efficiency . . . producing *all* available CO_2.

Combustion is performed at extremely high temperatures which completely eliminates condensable carbon and other objectionable by-products and provides a clean, tasteless CO_2 gas which requires no scrubbing.

Compressing clean, cool air and charging it into the pressurized CARBALL combustion chamber prevents hot corrosive gas troubles commonly found in older systems.

Request bulletins 7W83 for complete details of the CARBALL and 7W85 for discussion and charts dealing with the mechanics of recarbonation.

WALKER PROCESS

WALKER PROCESS EQUIPMENT INC.

Factory - Engineering Offices - Laboratories
Aurora, Illinois

WORTHINGTON-GAMON METER DIVISION

Worthington Corporation

NEWARK NEW JERSEY

Aerial view of Big Walnut plant. Built for City of Columbus, Ohio—Floyd C. Redick, Director, Department of Public Service; Paul C. Laux, Superintendent of the Division of Water. Uhlman Associates were the consulting engineers for design and construction.

Columbus, Ohio selects Leopold Filter Bottoms, Operating Tables and Carbon Slurry Agitators

Built at an approximate cost of $5,750,000, the Big Walnut project is designed to provide adequate water supply capacity to meet the ever-increasing needs of the City of Columbus. The new, modern facilities (shown above) have a nominal capacity of 50 mgd, a maximum rated capacity of 73 mgd, and are equipped with twelve Leopold five-valve operating tables, six Leopold carbon slurry agitators, and twelve sets of Leopold glazed tile filter bottoms.

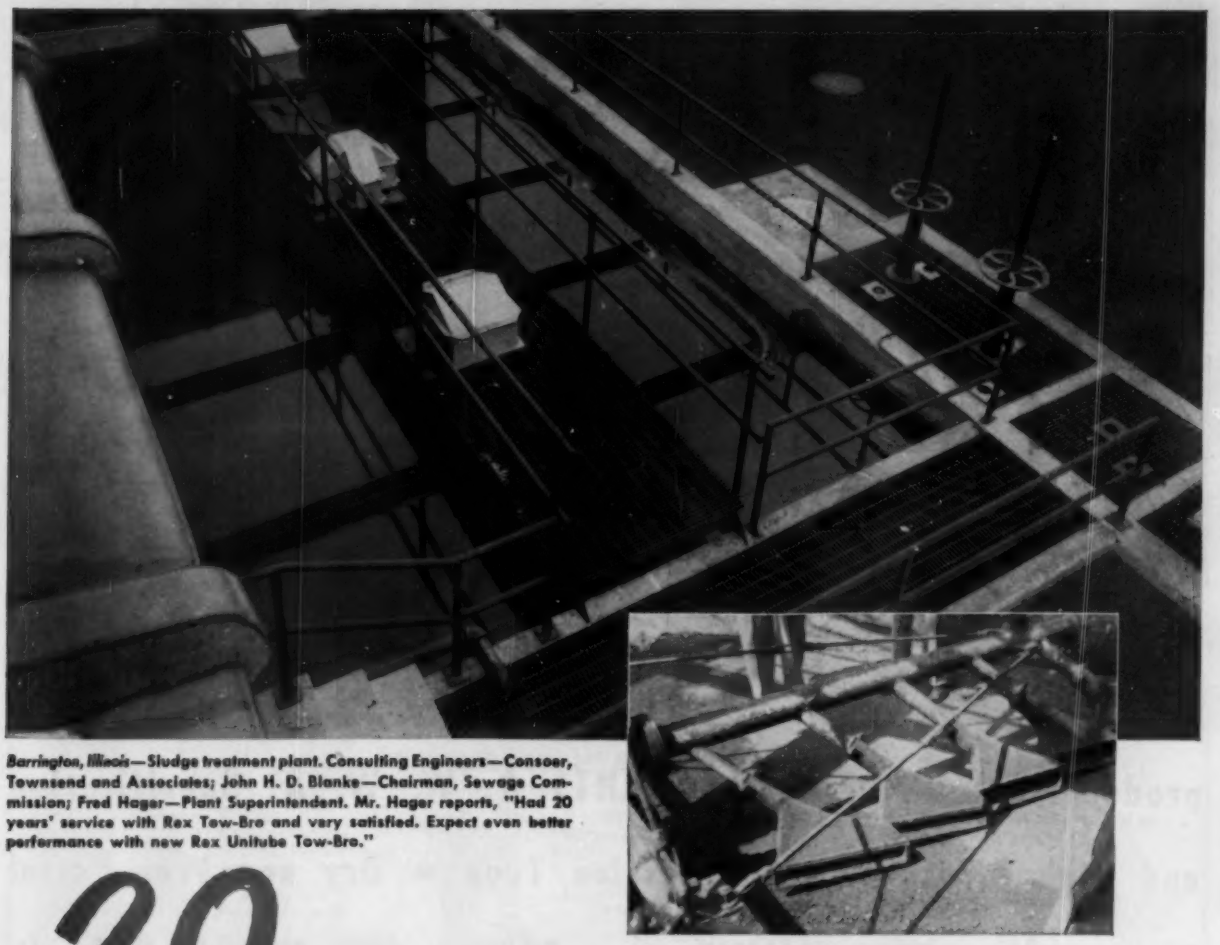
Like this new project, more and more water treatment plants are using Leopold equipment—whether for new construction or modernization programs. It will pay you big dividends to do the same! For details on Leopold water purification and filter plant equipment, write today. There's no obligation.

Leopold

F. B. LEOPOLD CO., INC.
ZELIENOPLE, PA.

COMPLETE WATER PURIFICATION AND FILTER PLANT EQUIPMENT · BUTTERFLY VALVES
FILTER OPERATING TABLES · MIXING EQUIPMENT · DRY CHEMICAL FEEDERS
GLAZED TILE FILTER BOTTOMS

REX® TOW-BRO®



Barrington, Illinois—Sludge treatment plant. Consulting Engineers—Consoer, Townsend and Associates; John H. D. Blanke—Chairman, Sewage Commission; Fred Hager—Plant Superintendent. Mr. Hager reports, "Had 20 years' service with Rex Tow-Bro and very satisfied. Expect even better performance with new Rex Unitube Tow-Bro."

20 years' steady service ...and look at its near-perfect condition!

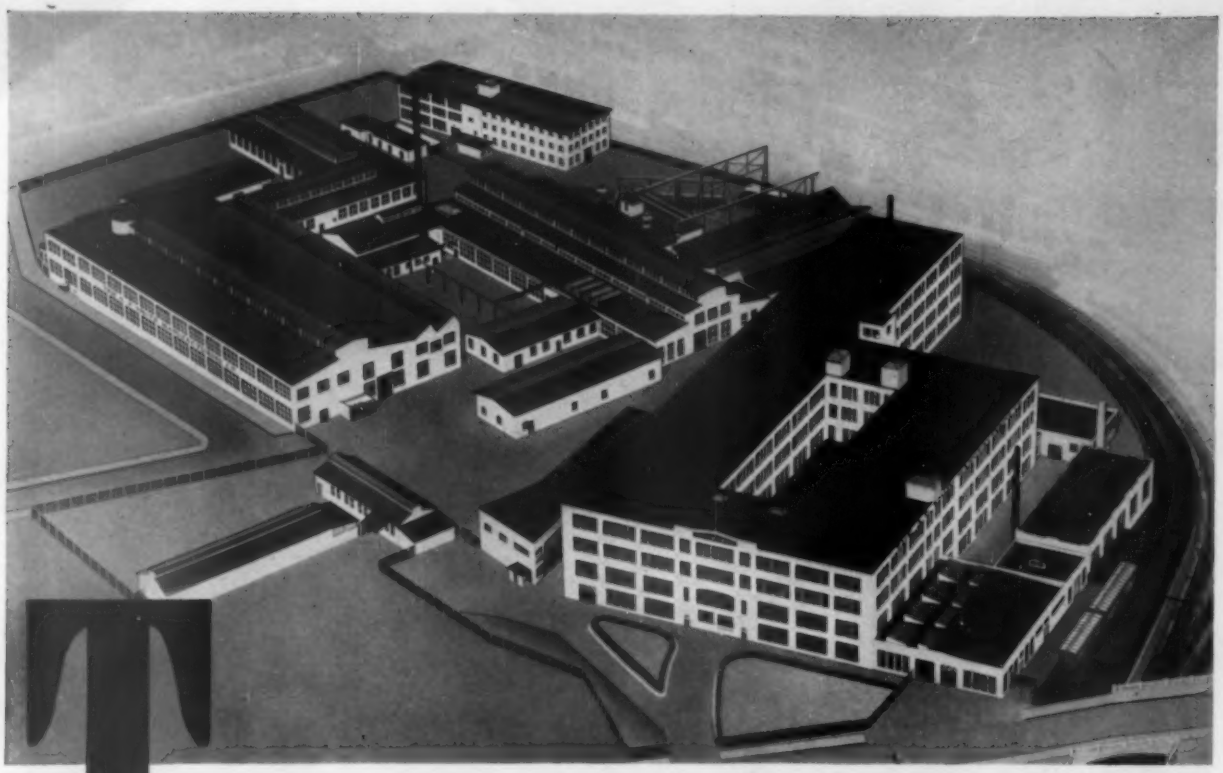
20 years, no trouble. That's the service record of Rex TOW-BRO at Barrington, Illinois. And a close look at this unretouched photo indicates there are 20 years' more service still there.

Long-time performance like this is essential to your plant, too. But more than this is the remarkable efficiency of the Rex TOW-BRO Sludge Remover. Now improved with new UNITUBE design, there is even more gentle suction action. Agitation is at absolute minimum. Sludge removal rate is faster, even with high solids concentration. It more effectively handles light, flocculent and "tricky" sludges.

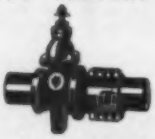
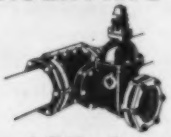
Most important to budget-conscious communities, this new simpler Rex UNITUBE TOW-BRO—while actually performing more efficiently—saves in equipment costs. Fits any tanks, new or existing. Bulletin No. 315-81 has the complete money-saving story. Write to: CHAIN Belt Co., 4610 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT COMPANY

MILWAUKEE 1, WISCONSIN



THE A. P. SMITH MANUFACTURING CO.

produces, FIRE HYDRANTS A. W. W. A. Specification and High Pressure — Compression Type — Dry and Wet Barrel Types. GATE VALVES sizes 2" thru 66", Manual, Hydraulic Cylinder, Electric Motor Operated for Low, Medium and High Pressure Service.  INSERTING VALVES sizes 4" thru 48" for inserting under pressure.  TAPPING SLEEVE AND VALVES sizes 4" x 2" thru 60" x 48" for branch connections under pressure.

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

FEEDING LIME?

...It's Omega Time!

FOR FEEDING AND SLAKING QUICKLIME IN LARGE PLANTS

Omega Lime Slaker with Loss-In-Weight Feeder

Accuracy — within ±1% of set feed rate (by weight)

Capacity — 50 to 12,000 lbs./hr.

Feed range — up to 100 to 1 on feeder . . . 10 to 1 on slaker

FOR FEEDING LIME SLURRY IN LARGE PLANTS

Omega Rotodip Liquid Feeder

Accuracy — within ±1% of calibrated rate

Capacity — maximum rates up to 1800 gph

Feed range — up to 100 to 1

FOR FEEDING HYDRATED LIME . . .

Omega Loss-In-Weight Feeder, Model 30

Accuracy — within ±1% (by weight) of set feed rate

Capacity — up to 2000 lbs./hr.

Feed range — as high as 100 to 1 if necessary

Omega Universal Feeder

Accuracy — within ±3% to 5% by weight

Capacity — 3 sizes for feed rates up to 5000 lbs./hr.

Feed range — up to 40 to 1 for any specific application

Omega Model 50A Disc Feeder

Accuracy — within ±3% to 5% by weight

Capacity — from 20 to 1700 cu. in./hr.

Feed range — up to 10 to 1 . . . any one of three change gears.

If you're feeding lime . . . quicklime, hydrated lime or dolomite, as a slurry or dry, at low or high rates . . . and want to do it economically, accurately, and dependably . . . investigate the advantages of Omega Feeders. For specific recommendations, send complete details of your feeding requirements . . . to

Omega Machine Co., 350 Harris Avenue, Providence 1, R. I.

OMEGA MACHINE CO.
DIVISION OF
B-I-F INDUSTRIES
METERS FEEDERS CONTROLS

MUELLER directory

of water works distribution and service products

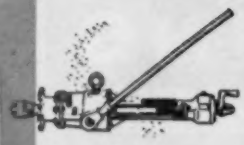
Mueller offers the most complete line of water distribution and service products – a line backed by a century of manufacturing experience and produced under a rigid standard of quality in workmanship and materials. You are assured of years of dependable service. Standardize on the Mueller line!

MUELLER PRODUCTS

...**Dependable since 1857**–for a century, Mueller Co. has been serving the progress of the water industry. Many new products, introduced during this first 100 years, have become the standard of the industry.

Clip These Pages as a handy reference

Sections referred to will be found in Mueller Water Works Catalog W-96. If you have mislaid your copy, or have need for another, contact your Mueller Representative or write direct.



Drilling Machines

For cuts ¼" through 12" under low or high pressure... Simple operation of machine keeps drilling operation under control at all times. (See Section 1).

Power Units

Air motor or gasoline engine drive unit may be used with the Mueller "C-1" or "DH-2" Drilling Machine for fast drilling operations. (See Section 1).

Tapping Machines

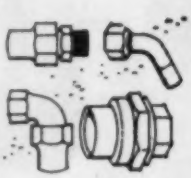
Drill and tap holes ½" through 4"... Insert corporation stops ½" through 2" or pipe plugs ½" through 4" under pressure. (See section 1).

Corporation Stops

Mueller, Iron Pipe, Hall or Wood Main inlets... For Copper service pipe... For thin-wall or small diameter pipe... With inside or outside I.P. threaded copper connection, lead flange or wiped joint... (See section 2).

Lead Goosenecks

Single in wiped joint, lead flange and solder joint types...Two, three, four, six and eight branch in wiped joint or lead flange types. (See Section 3).



Service fittings

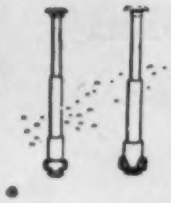
Copper Service Pipe...
Service pipe fittings and tees...
Branch connections...
Corporation stop couplings...
I.P. threaded copper pipe fittings...
Lead flange fittings...
Solder nipples and plugs...
(See section 4).

Service Clamps

Single or double strap types with neoprene or lead gaskets...Mueller or I.P. Thread. (See Section 5).

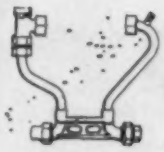
Curb Stops

Inverted key–copper service pipe or I.P. threads.
Solid tee head–copper service pipe or I.P. threads.
"H" pattern–copper service pipe or I.P. threads.
Blue Top–copper service pipe or I.P. threads.
Newport Pattern–I.P. threads.
Lead flange or wiped joint.
(See section 6).



Curb Boxes

Mueller extension type, arch pattern with optional footpiece or Minneapolis pattern... screw type with 2½" or 3" shaft, enlarged or bell bottom base for curb stops or wheel handle valves...Extensions and repair lids. (See Section 7).



Meter Setting Equipment

Copper meter yokes...
Iron meter yokes...
Meter relocaters...
Water meter couplings...
Meter box covers...
(See section 8).

Rough Plumbing

Ground key stops with or without drain... Compression stops with or without drain... Sediment and lawn faucets...Bronze gate valves...Ground key stops, angle pattern, with or without drain. (See Section 9).

Regulators and Strainers

For water, air, oil, gas or steam installations ...Pressure relief and check valves... Temperature relief valves and relief elbows ...Large diaphragm relief valves.
(See Section 10).

Tools

Pipe jointers, calking sets, yarning irons, hammers, chisels, flanging tools, copper service pipe tools, lead pipe flanging tools. (See Section 11).

Fire Hydrants

AWWA Improved, in 4¼", 4½", 5¼" and 6¼" sizes...Standard and flush types in 4¼" and 5¼" sizes...Standard and flush types in 2½" size...Underwriter approved type in 5¼" and 6¼" sizes...Variety of ends for different kinds of pipe. (See Section 12).

Gate Valves

AWWA Non-Rising Stem
Hub, flanged, hub and flanged...
Spigot, hub and spigot, flanged and spigot...
Mechanical joint...
Flanged and Mechanical Joint...
Universal, flanged and Universal, screwed...
Hub for asbestos cement...
Hub for steel pipe...
AWWA Sliding and Rising Stem
Flanged...
AWWA Outside Screw and Yoke
Hub, flanged, screwed...
(See section 13).

Cut-In or Tapping Valves

Tapping valves for use with tapping sleeve or cross...Calked and mechanical joint types ...Conventional or "O" ring stem packing... With or without indicator post flange...Cut-In Sleeve and Valve with conventional or "O" ring stem packing. (See Section 14).

Sleeves

Split repair and tapping...Calked or mechanical joint types...Tapping cross with calked or mechanical joint also available.
(See Section 14).

Inserting Valves

For inserting into mains while under pressure...Non-rising stem with Conventional packing...Gate valve mechanism is identical to Mueller AWWA Gate Valves.
(See Section 15).

Valve Boxes

Two or three-piece type, extension pieces, adapters and bases...Roadway screw type with arch or flange base and extension.
(See Section 16).

Miscellaneous Valves

Check, flap, mud or plug drain valves, shear gates, floor and bench stands, and indicator posts. (See Section 17).

Visit our new miniature water works distribution display at the main entrance of the convention hall in Atlantic City, May 12-17, 1957.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
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100th YEAR — SERVING the Water and Gas Industries — QUALITY

Since 1857

This AMVIT* SEWER LINE is a life line carrying industrial wastes to safe disposal

Carborundum Metals Company
Washington, West Virginia

Engineers and Builders
The H. K. Ferguson Company

This is the last time you'll see that length of pipe going into the ditch. Yet it will serve a new industrial plant for many years.

That sewer line will carry thousands of gallons of diluted acids, oils, alkali solutions and other waste material from Carborundum Metals new plant to a nearby treatment plant. Here the already diluted waste materials are made completely neutral and harmless to plant, animal and fish life. This line is one of the important life lines of that factory.

The Amvit joint was specified for this job because like the clay pipe it is unharmed by underground service.

A true mechanical joint, Amvit is made from plasticized resins of polyvinyl chloride. Thousands of feet of Amvit Jointed Clay Pipe have been installed on industrial waste disposal lines such as this.

Amvit Jointed Clay Pipe, in sizes 4" through 24", together with all fittings is available for immediate delivery in Northeast and Central States.

For more information, write or call American Vitrified Products Company, National City Bank Building, Cleveland, Ohio, or our office nearest you.

*T. M. Registered. Patents Pending.

The Amvit Joint is made of a plastic material with rubber-like characteristics. Like the pipe, the joint will withstand the most severe underground conditions. Amvit Joint is furnished on all fittings.

SINCE 1900

AMERICAN

American Vitrified Products Company

CLEVELAND, OHIO

MANUFACTURERS of: Clay pipe, flue liners, clay liner plates and concrete pipe.

Plants Across the Nation...Brazil, Indiana • Chicago, Illinois • Cleveland, Ohio • Crawfordsville, Indiana • Detroit, Michigan • East Liverpool, Ohio Fenton, Michigan • Grand Ledge, Michigan • Lisbon, Ohio • Los Angeles, California • Milwaukee, Wisconsin • South Bend, Indiana • Uhrichsville, Ohio

Soil conserved . . .

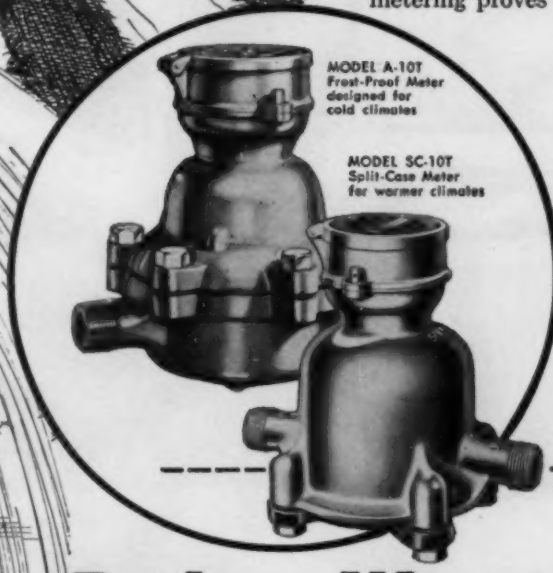
but how about our most precious possession . . . water?

Stop water waste . . . start water conservation now—with Badger Meters

We are paying billions for land conservation and reclamation because our very life depends upon it. And we are lucky — there's land to reclaim. But what about our diminishing water supply? When that's gone — then what?

That's why the time to start water conservation is *now*—with Badger Meters. They're the best investment you can make for your community's future. Badger Meters replace impractical and unjust flat rates with a fair-share, fair-pay program for everybody. Accurate metering proves to consumers that the best things in life are far from free. *That's* when water waste stops — conservation begins. What's more, Badger Meters put your water system on a profitable, business basis.

Choose the specific meters you need from the complete Badger Meter line of outstanding disc, turbine and compound meters — 5/8-inch through 12-inch sizes. They're precision-engineered, using the finest alloys for lasting, accurate service. Call a Badger Meter representative for facts — or write for literature *today*.



Badger Water Meters

Water is vital
Badger Meters have conserved it better for over 50 years.

BADGER METER MFG. CO. • 2371 North 30th Street
Milwaukee 45, Wisconsin • OFFICES IN PRINCIPAL CITIES

AMERICA'S INVISIBLE GIANT...

is the great, far-spreading and fast-growing aggregate industry!

It is the *indispensable* service industry to all construction projects. In 1957 more than $40,000,000,000 will be spent on public, private and Government construction projects. A large part of this huge expenditure will go toward the purchase of *aggregates*.

Vulcan Materials Company is a part of this mammoth, but little-known industry that is growing as America grows. Our purpose is to serve . . . to work with the people who build and construct . . . to provide the needed products and the service to complete every job on schedule.

"Wherever you see a bridge . . . a giant dam . . . glistening railroad tracks . . . a busy airport . . . a mighty canal lock . . . the ribbons of asphalt and concrete highways . . . there, you see the results of our vast, quietly-working industry. We are proud to be a part of it. We are expending every effort, making every investment to increase our stature in it . . . and in its contribution to our nation's growth and prosperity."

P. W. Tuelond
President

VULCAN Materials Company

2019 Sixth Avenue, N., Birmingham, Ala.

Birmingham Slag Division
Southern Cen-Vi-Ro Pipe Corp.
Kennesaw Stone Company
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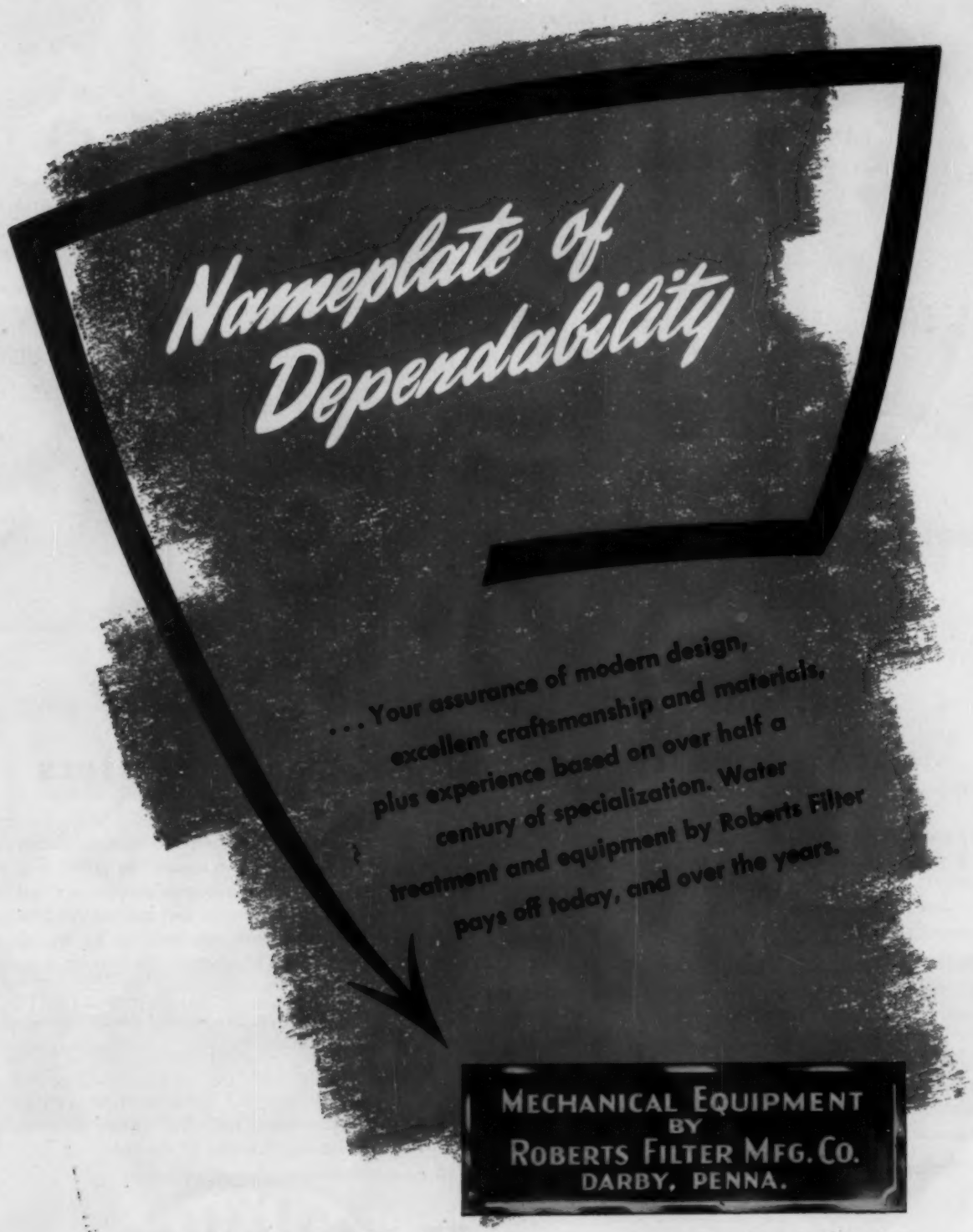
Nameplate of Dependability
. . . Your assurance of modern design, excellent craftsmanship and materials, plus experience based on over half a century of specialization. Water treatment and equipment by Roberts Filter pays off today, and over the years.
MECHANICAL EQUIPMENT
BY
ROBERTS FILTER MFG. CO.
DARBY, PENNA.

Valdese Filtration Plant (below), designed by W. K. Dickson & Co., built by Boyd and Goforth, Inc. Complete operating data for the plant is concentrated on Honeywell panel, at left. Below at left is one of the consoles for controlling filter operation.

Honeywell FiltermatiC* System automatically controls rapid sand filters

THE Valdese Water Filtration Plant, Valdese, N. C., is designed for maximum simplicity and convenience. Complete supervisory data on the entire operation is concentrated on a Honeywell panel . . . and individual control consoles are provided at each filter location.

The Honeywell FiltermatiC System includes direct pneumatic operation of filter control valves, without need for complex pneumatic-hydraulic relays. Valves 16" and larger can be opened or closed at the turn of a switch. Rate of filtration, too, is a single switch adjustment . . . and control provides for automatic plant shutdown when levels in reservoir and clear wells reach maximum limits.

FiltermatiC Systems are available in a variety of forms . . . offer a unique combination of design, operating and maintenance features which assure low initial cost and continuing economy. Components are compact and free from the limitations of cables and mechanical linkages. Spare parts requirements are reduced by the use of interchangeable units. Maximum effectiveness is accomplished with minimum attention.

Ask your local Honeywell sales engineer to discuss your specific filtration requirements . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

*Trademark of Minneapolis-Honeywell Regulator Co.

Visit with Honeywell
Booths 608-10-12
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Honeywell
BROWN INSTRUMENTS
First in Controls

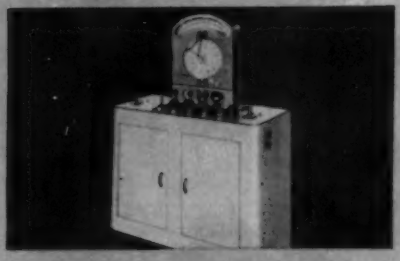
You get BEST performance at LOW cost with INFILCO water treatment equipment

ACCELATOR®

high rate treatment plant saves up to 80% of space.

Clarifies or softens and clarifies in a *single* basin, replacing separate slow-rate mixing, coagulation and sedimentation basins. Produces clearer, more stable effluent. "Slurry contact," not "sludge blanket" unit.

Bulletin 1825

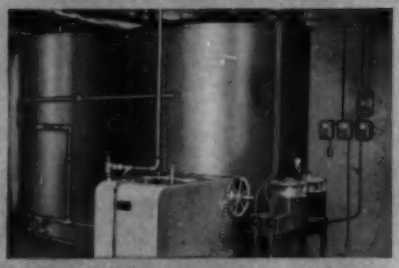


C.A.P. SYSTEM®

automatic instruments for pneumatic control of operation.

Most advanced types for sensitive flow control and accurate measurement of loss of head and rate of flow. Contribute substantially to maximum plant efficiency.

Bulletin 1100



ACCELAPAK®

treating plant... complete in a single unit.

Clarifies or softens and clarifies from 15 to 350 G.P.M. Ideal for small communities, industrial plants, etc. Easy and economical to install.

Bulletin 1870

DRY FEEDERS, TYPE E

provide automatic proportional or constant rate feeding.

Only feeder with linear feed adjustment throughout capacity range of feeder; extrusion type, simultaneous rocking and reciprocal motion to feed pan.

Bulletin 215

RECARBONATORS

greater efficiency in much less space at much lower cost.

Revolutionary design eliminates costly cooling apparatus and exposed hot gas lines; occupies less than ⅓ space of old style systems. Centralized controls.

Bulletin 1320

INFILCO
INCORPORATED
General Offices • Tucson, Arizona • P.O. Box 5033
Field offices throughout the United States and in foreign countries

These are only a few of the products for water treatment in the complete INFILCO line, which includes plants and equipment to meet your every need. INFILCO's improved equipment gives you the highest quality production in much less space—cuts construction cost to a minimum—provides you with the most modern installation at lowest total installed cost.

It will pay you to investigate INFILCO equipment. Write today for bulletins of interest to you.

See your Consulting Engineer. If you are planning *any* major installation, the services of a reliable Consulting Engineer can be invaluable. He will design your plant and help you select the type of equipment that best meets your requirements and budget.

Inquiries are invited on all problems in the treatment of water, sewage and wastes for municipalities, institutions and general industry. Complete laboratory facilities available for special treatment problems.

INFILCO

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THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

slips on like

U.S. cast iron **PIPE** FOR WATER, SEWERAGE AND

an old shoe

But once *in*, our revolutionary new "Tyton Joint" pipe seals bottle-tight. Hydrostatic tests on restrained "Tyton Joints" show that they will withstand pressures well in excess of hydrostatic test pressures required by the pipe specifications.

And only *one* accessory needed...a simple rubber gasket. This gasket fits into the bell end, and the connecting pipe compresses the gasket and seals the joint permanently. No bell holes. No delays. "Tyton Joint" pipe can be laid in rain or a wet trench. And even the newest crew can handle it.

Like full information on "Tyton Joint" pipe whose installation is simple, speedy and sure? Call or write us today and get the facts that will save you time, trouble, money in the trench.

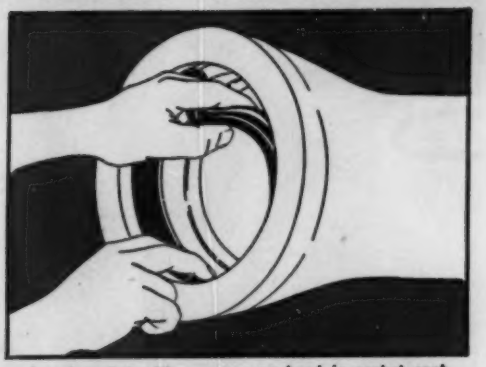
U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE

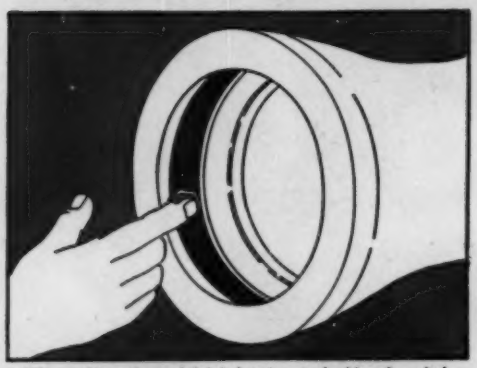
INDUSTRIAL SERVICE CAST IRON

U. S. TYTON JOINT

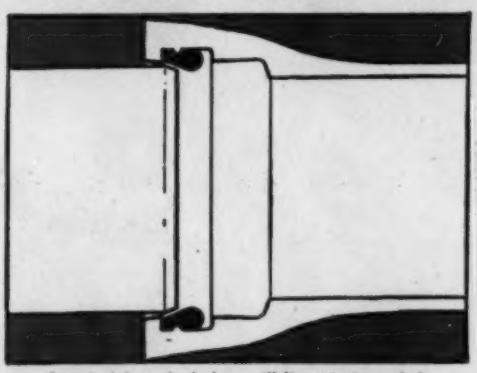
ONLY FOUR SIMPLE ACTIONS



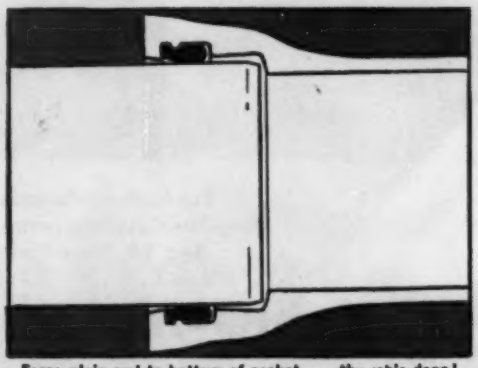
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket . . . the job's done!

GOING IN...

...a long-term community investment

It's Transite Ring-Tite Pressure Pipe

• Transite® Ring-Tite® Pressure Pipe is a community investment that pays off year after year!

Its remarkably high flow characteristics protect that investment by keeping maintenance and pumping costs at a minimum during its long service life.

Corrosion Resistant

Transite Pipe is strong, durable, and highly resistant to corrosion. And it is immune to tuberculation, the form of interior corrosion that chokes the flow and increases pumping costs. Transite cannot tuberculate, thus its original high flow capacity is maintained, and pumping costs are kept at a minimum year after year.

The Ring-Tite Coupling, with rubber rings compressed and locked in place forms a joint that is tight yet flexible. Rings cannot blow out, and the automatic separation of the pipes within the coupling helps to relieve line stresses.

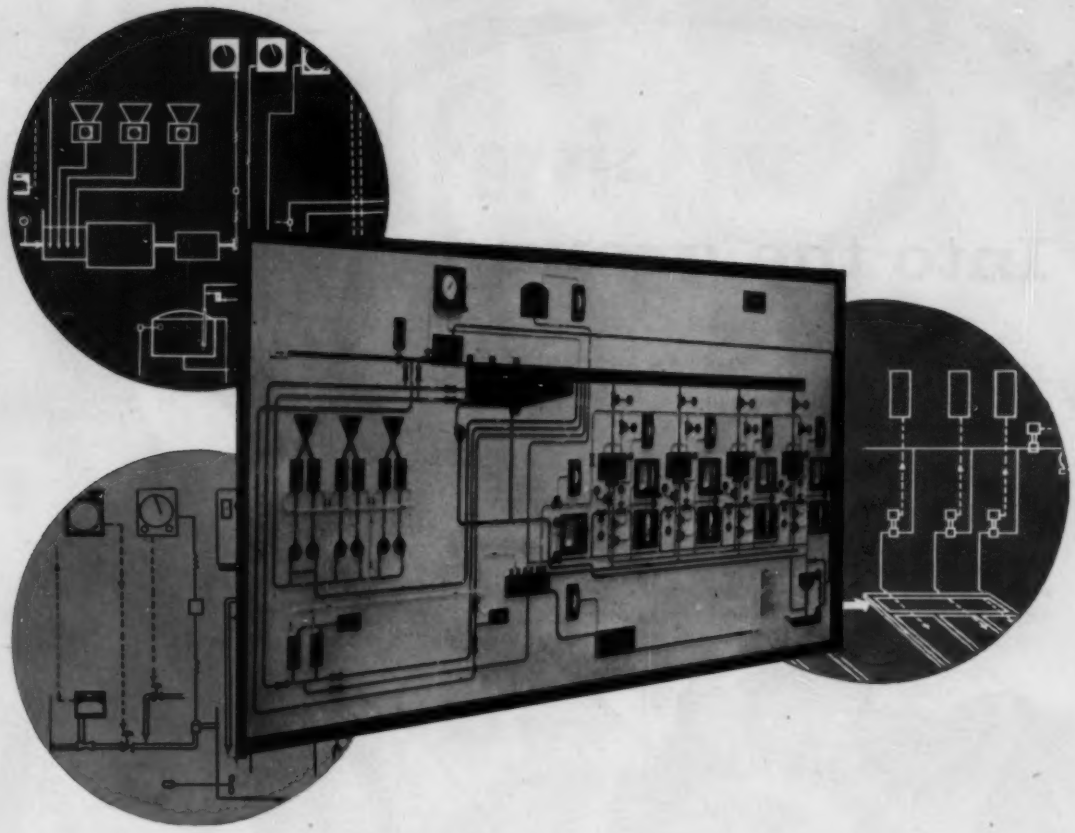
See us at Atlantic City . . .
Booth Nos. 527 through 531

For further information about Transite Pressure Pipe and the Ring-Tite Coupling, write for Booklet TR-160A. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE PRESSURE PIPE

WITH THE **RING-TITE** COUPLING



in water, waste, and sewage treatment . . .

A CONTROL SYSTEM IS WHAT YOU MAKE IT

There's more to a control system than just the instruments. First, there has to be a plan that ties them together. Whether you need a simple metering facility, or a complex control network for one-man operation, Fischer & Porter will work with you in formulating such a plan. Drawing upon broad experience in every area of water, waste, and sewage treatment, Fischer & Porter can provide all the equipment necessary to measure, record and control . . . including graphic centralized control panels and automatic data logging systems, chlorinators and chemical feed equipment.

For a small system or a large one, there's much to be gained from this approach. Fischer & Porter alone offers you the benefits of unified responsibility at every step—through analysis, design, manufacture, installation, start-up, and operator training. If you'd like to hear more about this service, contact the Fischer & Porter field engineer serving you . . . or write Fischer & Porter Co., 157 Fischer Road, Hatboro, Pennsylvania.

FISCHER & PORTER CO.

Complete Process Instrumentation

Into the ground with ease, and for keeps

K&M ASBESTOS CEMENT PIPE

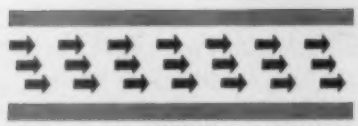
It's the modern pipe! Easy installation under any weather and ground conditions is just one of the advantages of K&M Asbestos-Cement Pipe. Other advantages: Permanently smooth non-tuberculating bore; non-corroding inner and outer surfaces; high resistance to electrolytic action; permanence of joint obtained quickly with exclusive K&M "Fluid-Tite"® Coupling.

K&M Pressure Pipe meets A.W.W.A., A.S.T.M., and U.S. Federal Specifications, and has Underwriters' Laboratories approval for all sizes (pipe and couplings) in Class 150.

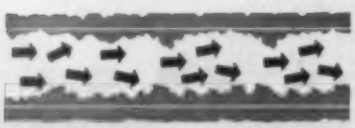
FOR GRAVITY SEWER SYSTEMS, K&M Sewer Pipe is the low-cost answer. "Fluid-Tite" Coupling makes permanent tight joint, prevents infiltration and root entrance.

FOR HOUSE-TO-SEWER CONNECTION, K&M Building Sewer Pipe and 2-step couplings round out the K&M family of asbestos-cement pipe.

Get the whole story on the modern pipe from the K&M distributor. *And visit us at our booth at the A.W.W.A. Convention, Convention Hall, Atlantic City, N.J., May 12-17, 1957.*



After many years, K&M Pipe hasn't tuberculated, bore remains unchanged, and full flow continues.



Old-fashioned pipe tuberculates over the years, requires higher pumping pressure, frequent cleaning.

K·M

KEASBEY & MATTISON Company • Ambler, Pennsylvania

In Canada, it's ATLAS ASBESTOS CO., Ltd., 5600 Hochelaga St., Montreal, P.Q.

for "CENTURY" Pipe and "FLUID-TITE" Coupling

TENNESSEE CORPORATION

Ferri-Floc

FERRIC SULFATE

The Superior COAGULANT

With The Plus FACTORS—

Ferri-Floc gives smoother, more efficient and trouble free operation. Whatever your particular water treatment problem may be, you can depend on Ferri-Floc doing a superior job and doing it efficiently and economically—Ferri-Floc is a free flowing granular salt which can be fed with few modifications through any standard dry feed equipment. It is only mildly hygroscopic, thereby permitting easy handling as well as storage in closed hoppers over long periods of time.

Ferri-Floc
FERRIC SULFATE

WATER TREATMENT

Efficient coagulation of surface or well water. Effective in lime soda-ash softening. Adaptable to treatment of all industrial applications.

SEWAGE TREATMENT

Ferri-Floc coagulates wastes over wide pH ranges — It provides efficient operation regardless of rapid variations of raw sewage — Is effective for conditioning sludge prior to vacuum filtration or drying on sand beds.

LIQUID SULFUR DIOXIDE
HIGHEST QUALITY
SO_2

SULFUR DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULFATE

COPPER SULFATE will control about 90% of the micro-organisms normally encountered in water treatment more economically than any other chemical.

- Excellent taste and odor control
- Increased filter runs
- Coagulation over wide pH ranges
- Rapid floc formation
- Bacteria removal
- Turbidity removal
- Ease of Operation
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- Economy

FREE BOOKLET

Let us send you without charge, a 38 page booklet that deals specifically with all phases of coagulation—just send us a postal card.

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617-629 Grant Building, Atlanta, Ga.

A Salute to the

WATERWORKS SUPERINTENDENTS

of American Communities

No office in a municipal government is more important to public welfare and safety than that of the Waterworks Superintendent. He is responsible for the lives and property of the entire citizenry. On his shoulders rests the responsibility of seeing that an adequate water supply and service is maintained to protect the public health, furnish fire protection, and meet the rapidly growing water demands of industrial and individual consumers. He is an active factor in helping his community grow from a town to a prosperous and healthy city. His salary should be commensurate with the vital service he performs.

An overwhelming majority of experienced and capable Waterworks Superintendents and Consulting Engineers recommend—

Permanent CAST IRON PIPE

when their communities are planning new or enlarged waterworks or sewage system. They know that Cast Iron Pipe has an unmatched record of long life with minimum maintenance cost and maximum saving to taxpayers.

WOODWARD IRON COMPANY

Since 1882

WOODWARD, ALABAMA

Our Company does not manufacture pipe, but has long supplied the nation's leading pipe manufacturers with quality iron from which quality cast iron pipe is made.

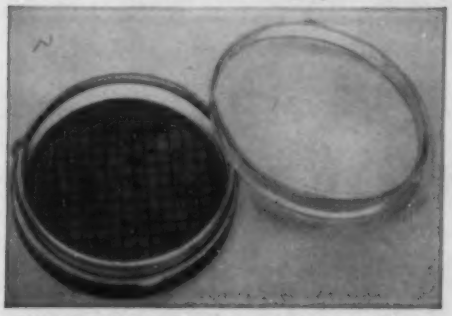
Water Testing

*APPROVED Water Pollution Control Technique

in the Laboratory

with the MILLIPORE FILTER STANDARD METHOD

NOW APPROVED as an alternate Standard Method for coliform testing, the MILLIPORE FILTER technique allows the determination of potable water quality to be carried out more RAPIDLY, more ECONOMICALLY, and with much greater ACCURACY than ever before possible. Results are obtained up to 5 times faster—in 16 to 20 hours—and with 2 to 5 times the precision of present broth tube methods. No tubes to wash, no breakage problems—the MF® technique saves valuable time, saves money, saves space.

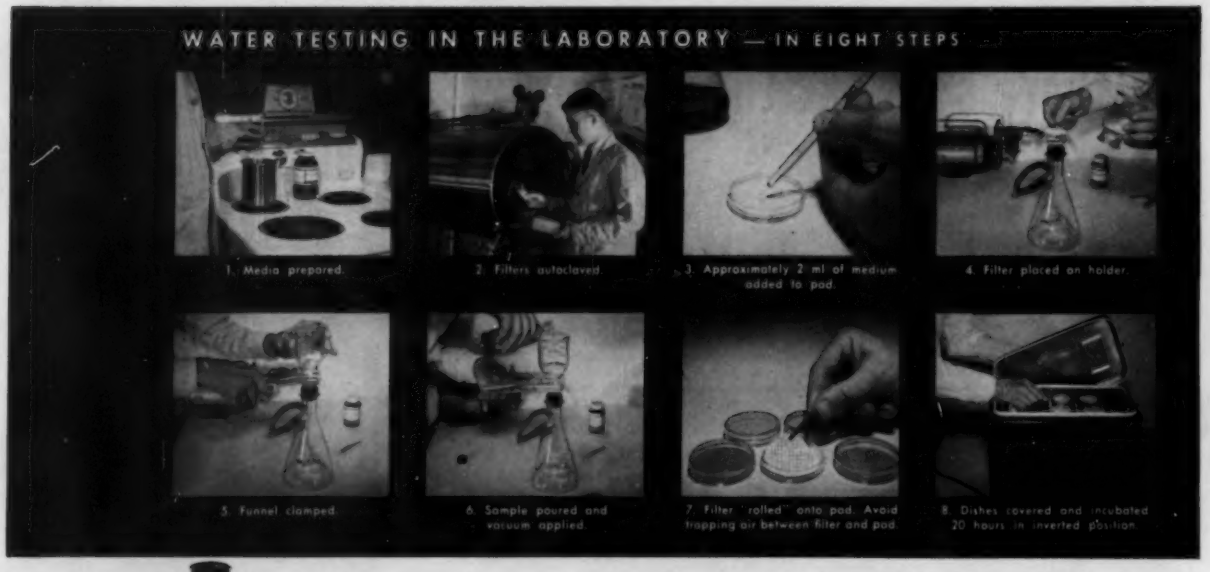


MILLIPORE FILTER in Disposable Plastic Petri Dish showing typical Coliform Bacteria Sheen Colonies, indicative of water contamination. MF® incubated for only 18 hours at 35°C.

MILLIPORE FILTERS are conveniently packaged in resealable Kraft envelopes—10 filters and nutrient pads per envelope—ready for immediate autoclave sterilization. Grid-marked to facilitate colony counting, the MF® may be readily filed as a permanent record of test results.

REGULATIONS SENSIBLY REQUIRE THAT PARALLEL TESTING OF THE MF® TECHNIQUE AND PRESENT METHODS be conducted in each laboratory to assure results of equivalent sanitary significance before adopting the new Standard Method. Full details on establishing MILLIPORE FILTER techniques in your laboratory are immediately available upon request.

Write for a copy of the new color-illustrated booklet,
"The MILLIPORE FILTER Standard Method of Water Bacteriology."


WATER TESTING IN THE LABORATORY — IN EIGHT STEPS
1. Media prepared.
2. Filters autoclaved.
3. Approximately 2 ml of medium added to pad.
4. Filter placed on holder.
5. Funnel clamped.
6. Sample poured and vacuum applied.
7. Filter "rolled" onto pad. Avoid trapping air between filter and pad.
8. Dishes covered and incubated 20 hours in inverted position.

MILLIPORE FILTER CORPORATION

36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS, U.S.A.

In Every Price Bid . . .
"There is hardly anything in the world that some man cannot make a little worse and sell a little cheaper"
—Ruskin

there's a cost that stays *Sealed* for seven years

All water meters are fine instruments. Any fine instrument loses accuracy as it wears. Because of this fact, written between the lines of any water meter price are two items you can't read for many years. Yet they are vital in choosing the lowest "total price."

First, as a meter loses accuracy, it gives away revenue. Before its first overhaul it may give away twice as much money as it seems to save in its "low bid" original price.

Secondly, to keep the meter accurate you may have higher repair costs over the years . . . or premature scrap-and-replace costs. Good meters often vary widely in this respect.

Tridents are preferred because they earn more and cost less in the long run. They never become obsolete. You modernize your Tridents as you repair. Ask your neighbor . . . or ask Neptune for details.

275

neptune

NEPTUNE METER COMPANY

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NEPTUNE METERS, LTD.

1430 Lakeshore Road • Toronto 14, Ontario

Branch Offices in Principal American and Canadian Cities.

WATER & SEWAGE WORKS

VOL. 104, NO. 5 • A Scranton Gillette Publication • MAY, 1957

ARTIST'S drawing of the new $2,300,000 Operations Center.

New Operations Center

For Indianapolis Water Company

INDIANAPOLIS WATER Company this summer will move into its new $2,300,000 Operations Center. This event will mark the culmination of an effort initiated in 1944 when a preliminary study and plans for a new distribution department headquarters were authorized. Nothing came of this effort except the construction of a much needed pipe storage yard adjacent to the area where it had been proposed to build the distribution department headquarters.

The project was revived in 1952.

Lewis S. Finch

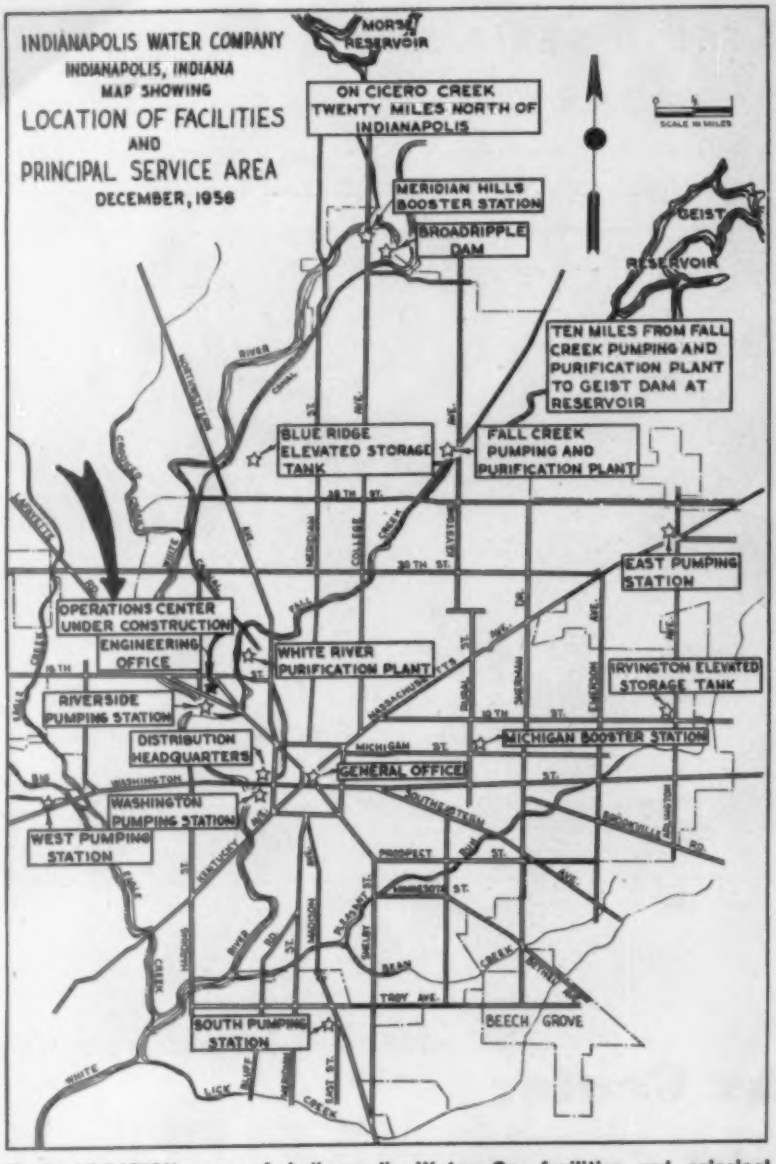
by LEWIS S. FINCH* and GERALD S. LYONS

Mr. Finch is Vice President and Chief Engineer of the Indianapolis Water Company.

Mr. Lyons is Assistant Engineer on Mr. Finch's staff. He has had much to do with the prosecution of this project.

*Mr. Finch has the distinction of being Vice President Elect of the Am. Water Works Association

Gerald S. Lyons



Pl. 1—LOCATION map of Indianapolis Water Co. facilities and principal service area.

By then, it had been broadened to include provisions for the general administrative and engineering offices in addition to the distribution department headquarters. After several sites were considered, it was decided to locate these combined facilities on a large tract which had been acquired as a well site in 1889 and on which new pipe yards had been built in 1948. This location is across the street from the Water Company's major pumping station and is also near the important White River Purification Plant. (Plate 1)

Bids were taken, contracts awarded, and construction of the Center was started just one year ago on May 7, 1956. Work since has been proceeding expeditiously.

What the Center Consists Of

The Center consists of an office building to which is attached a garage and shops. The garage has a capacity of 70 vehicles. It now is anticipated that the office building portion will be ready for occupancy late in the summer of 1957. It will be sometime later, perhaps late October, before the garage and shops are completed.

The office building portion of the Center is two stories in height with a partial basement. Including the basement, the office building contains approximately 72,700 square feet of floor area. The portion of the Center given over to the garage and shops has a total area of 40,800 sq. ft., 31,000 sq. ft. being for the storage of vehicles.

When completed, the Operations Center will accommodate the executive, administrative, accounting, engineering, and distribution departments as well as the supervisory personnel of the pumping department.

The Indianapolis Water Company now employs approximately 350 people of whom 225 will be housed in the Operations Center. Provision has been made for accommodating at least 60 additional people as the number of employees increases.

Water Works History and Growth

Indianapolis has been served by a privately owned and operated public water supply system since 1871 when the ill-fated Water Works Company of Indianapolis laid the first mains. The management of this enterprise was unsuccessful in interesting the people of the Hoosier capitol in the use of its facilities. And, in 1881, its assets were sold at a sheriff's sale to the present Indianapolis Water Company. The development of this new company was slow but steady during the first half century of its existence. The depression of the 1930's, however, stopped this growth. After World War II, the upward trend again was started as a result of the greatly accelerated industrial expansion in the Indianapolis area. To meet this expansion, the Indianapolis Water Company's distribution system has been increased from 751 miles in 1946 to 1,106 miles at the end of 1956. This comprises a growth of 50 per cent in ten years.

The city's industrial output between 1939 and 1956 increased, percentagewise, one-fourth more than the national average. During the same period, factory employment in the Indianapolis area has doubled—a rate of increase nearly 50 per cent greater than the nationwide average. Compared with the growth of certain southwestern and far western cities, this rate of growth may not appear to be phenomenal, but it has been both substantial and permanent.

Largest City Served by Private Water Utility

Today, Indianapolis is the largest city in the United States being served entirely by a privately owned water utility. Further, it shares with Dallas the dubious distinction of being the largest city in its population class not

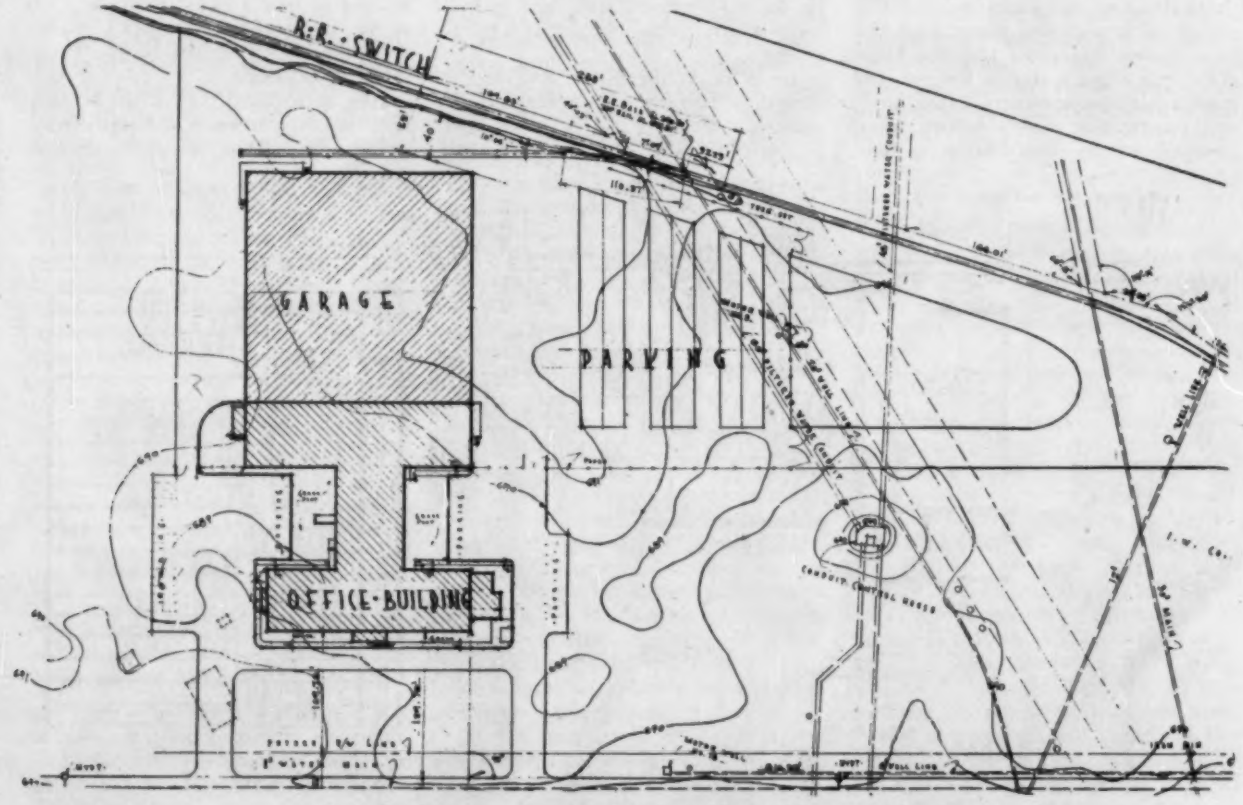
LONG-TIME location of Water Company Office at "the hub"—on renowned Monument Circle.

having a large body of water or a large river from which its public water supply can be obtained. Indianapolis has the edge on Dallas in one respect, however, in that it does rain in Indianapolis.

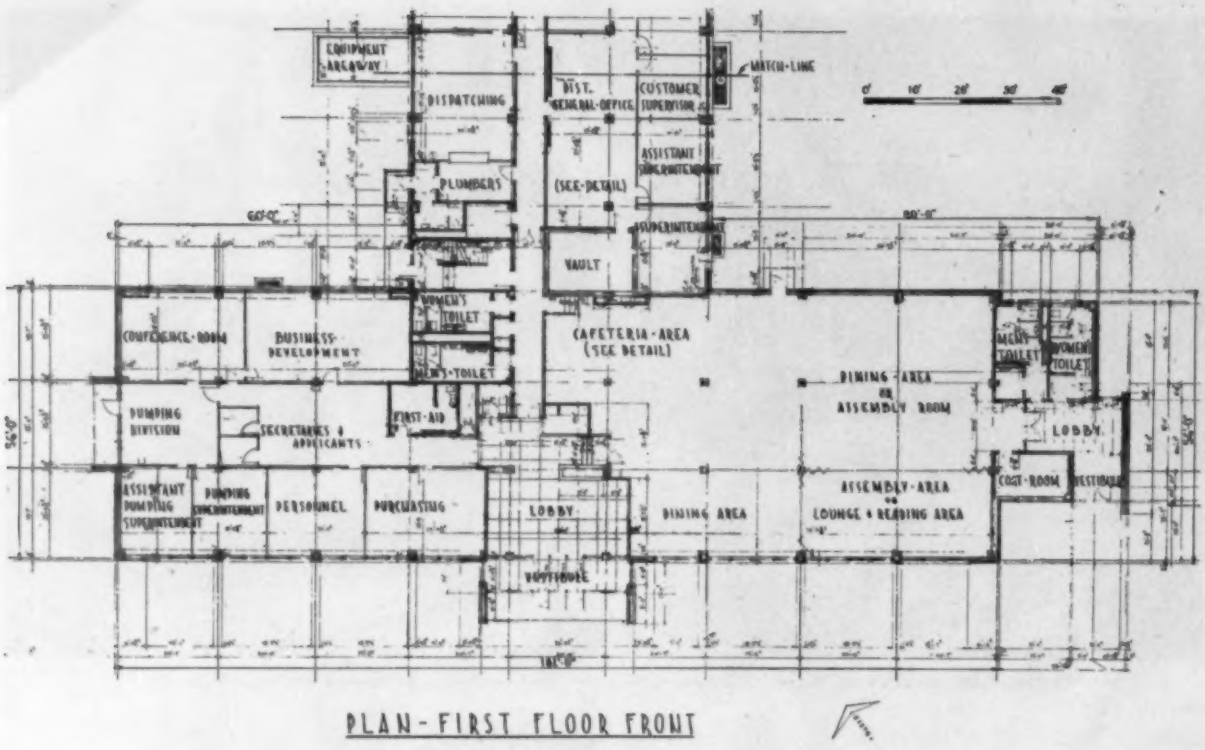
In spite of the limited surface water sources available, Indianapolis stands with the few large cities of the country which have not found it necessary to restrict the use of water. This record has been maintained only by the foresight and constant persistence of company management in planning ahead.

Facilities and Service Area

The primary source of the Indi-



Pl. 2—SITE plan shows relationship of buildings and relative sizes.

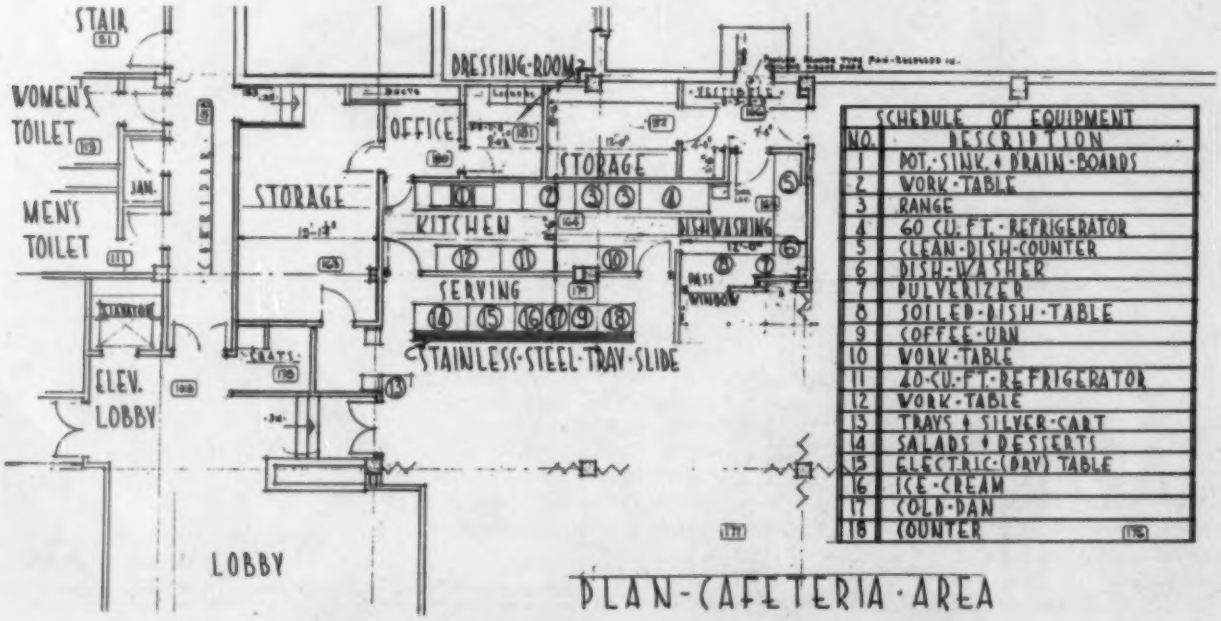


Pl. 3—OFFICE building—first floor front section.

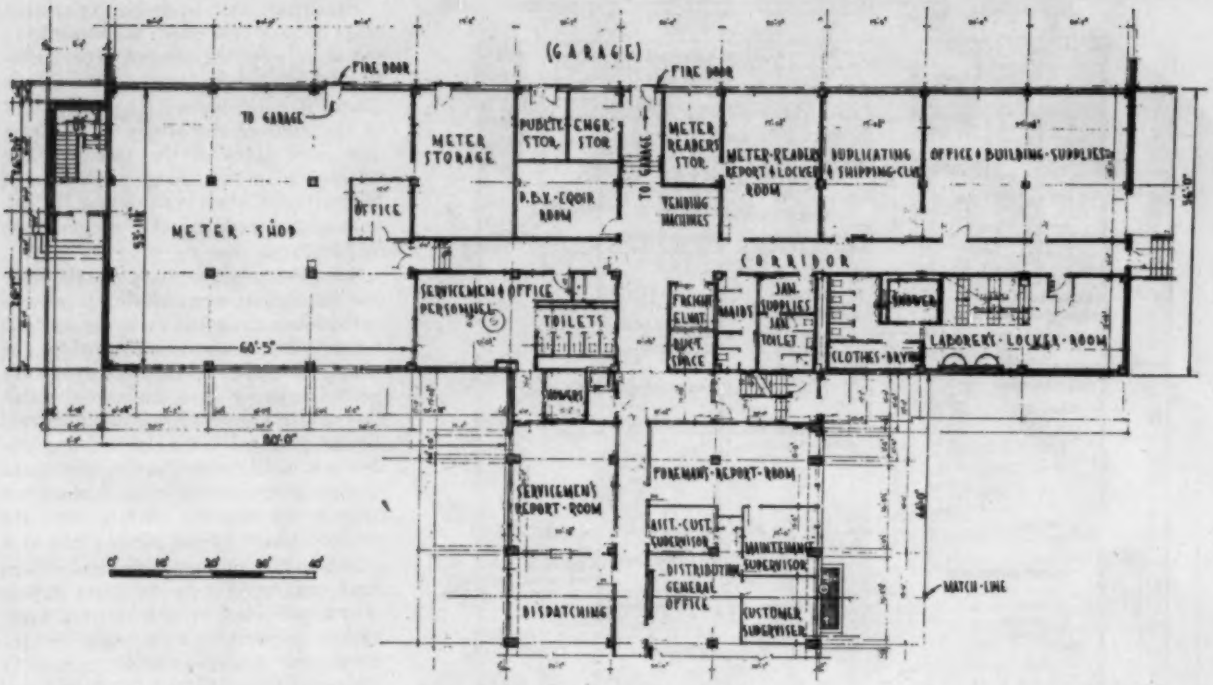
anapolis water supply is the flow of White River and Fall Creek augmented when necessary by the discharge of impounded water from the new Morse Reservoir and the Geist Reservoir. The water is filtered and purified in the company's two modern purification plants before being pumped to the distribution system. These surface water supplies are supplemented when the occasion demands by water from 60 rock and gravel wells which are maintained as a ready reserve.

In 1956, White River and Morse Reservoir furnished an average of 40 million gallons of water a day, or 63 per cent of the city's demand upon the system. Fall Creek and Geist Reservoir provided an average of 23 million gallons a day, or 36 per cent of the supply required. Approximately one per cent of the supply came from the 60 wells.

It is anticipated that, if the stream flow is not materially diminished by withdrawal of the water for irriga-



Pl. 4—CAFETERIA and kitchen arrangement considered a very worthwhile addition.



PLAN - FIRST FLOOR - REAR

Pl. 5—FIRST floor rear section—meter shop, distribution, construction and maintenance divisions.

tion or other consumptive purposes, the present water resources of Indianapolis Water Company are sufficient to meet the demands of the city until 1970.

The locations of the principal facilities maintained by the Water Company are shown on Plate I.

In addition to the city of Indianapolis, the territory now being served by the Water Company includes the satellite incorporated cities and towns of Beech Grove, Woodruff Place, Warren Park, Meridian Hills, Southport, Homecroft, Williams Creek, Lynnhurst, Crows Nest, North Crows Nest, and certain unincorporated areas adjacent to the city. It is, perhaps, noteworthy that no water is sold through master meters for resale —the water being sold by the Water Company directly to the customers.

This territory constitutes an integrated area of approximately 87 square miles with a population estimated to be in excess of 530,000. At the end of 1956, the company had 126,326 customers.

New Office Building and Distribution Headquarters Needed

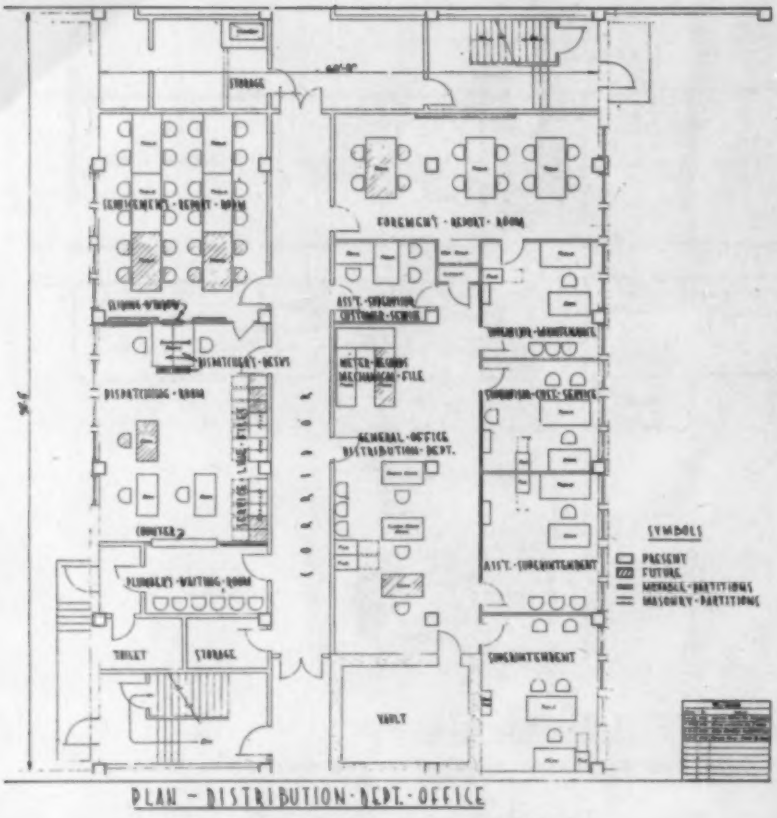
As may be seen on Plate I, the company's general office, the engineering department headquarters, and the distribution headquarters are widely separated. Also, the premises and facilities available to these agencies are definitely inadequate. Lost motion and consequent impairment of supervisory and administrative efficiency has resulted. The distribution department especially has been hampered in its rapidly expanding operations by its wholly inadequate headquarters' facilities.

With supervisory and executive offices located in five scattered buildings—in some cases, miles apart—the need for consolidation was hardly debatable. Consideration had to be given, however, to the degree of consolidation to be accomplished. At first, it was not believed that a single location could be found which would accommodate the needs of both the general office and the distribution department headquarters. The Water Company's general offices, located for generations in the center of the business district and upon renowned Monument Circle, had become somewhat of a landmark—outdated, it is true—but nevertheless the need for a centralized location had become so firmly fixed in almost everyone's mind that it did not appear feasible even to consider moving these offices to an outlying area which would provide a suitable location for the Distribution Department.

It was recognized, nevertheless, not only that the present facilities were inadequate and would have to be replaced, but also that the Monument Circle location had become too valuable to be continued as the site of the Water Company offices. Other downtown locations were sought but no satisfactory quarters for *all* of the offices could be found. In the meantime, the trend toward decentralization had become more pronounced and personal customer contacts less frequent.

Outlying Location Acceptable

Finally, in 1952, it was decided that it would be feasible to move the general offices away from downtown if a separate small collections and customer contact office could be established in a convenient downtown location. It was determined that this could be done and the die was cast. No longer did it appear impracticable to locate the general offices in an outlying area where the distribution headquarters also could be maintained properly. Pursuant to this decision, the Water Company engineering staff, in close cooperation with department heads, studied the needs of the departments to be housed in the new location and their functional relations with each other. Based upon this information, a number of preliminary layouts were developed until finally it was decided to combine the general offices under one roof with the distribution department facilities and locate it adjacent to the pipe



Pl. 6—DISTRIBUTION and service offices.

yards which had been partially developed in 1948. The resulting combination of office building, service center, and garage then became known as the "Operations Center".

Location of the Center

The Operations Center is located in an open area on Speedway Ave. about ten minutes from the heart of the business district. Streets lead away from the location so that the distribution department vehicles can proceed to almost any part of the city without being forced to pass through the congested mid-city area. (See Plate 1)

The area adjacent to the location of the Operation Center is so "criss-crossed" with pipe and conduits leading to and from Riverside Pumping Station that it always must remain unoccupied. It thus provides a park-like location with plenty of space for parking, tennis courts, and even a ball diamond should one ever be desired.

Public transportation facilities (buses) are reasonably available to the site.

Winged Type vs. Block Shaped Building

In developing a functional layout for the Operations Center, it was determined by the engineering staff that a wing type building would provide more convenience in operation than could be attained with a block type building. Further, after many layouts of both types had been made, it was concluded that a wing type building could be built with very nearly the same first cost and could be operated as economically as could a rectangular building providing comparable functional efficiency. This did not appear reasonable at first; but, after making exhaustive attempts to adapt the block building to the functional requirements, it was decided definitely that the value of the greater functional convenience of the wing type building would compensate for its slight extra cost over that of a rectangular building.

It was found that the area of the block type building would have to be made greater because more corridor space was required to serve the rooms. On the other hand, there would be less exterior wall necessary with the block type and a savings in wall construction would result. This savings was offset, however, by the additional cost of interior partitions along the longer corridors, and the extra cost of providing the additional space required in the block plan.

Studying the probable operating costs to heat and cool (air condition) the more exposed winged type building compared to one of the block shape, if windows were to be left out of the ends of the wings on the east and west sides of the building, the difference in operating costs seemed insignificant when considering the advantages offered by the winged type building.

In making preliminary layout studies for every new building, careful consideration should be given to both types before a decision regarding the shape is made. Obviously, in a congested area or in a high land value district, the block type building would be the better. Where the building can be built in the wide open spaces, as at Indianapolis, functional convenience may quite possibly dictate that the winged shape be adopted.

After the engineering department had completed a preliminary layout which provided for the desired functional relationships as well as the necessary facilities, local architects, Daggett, Naegele & Daggett, were retained to restudy the preliminary layouts and to develop final plans. After studying the operational and functional problem peculiar to Indianapolis Water Company, they concurred with the engineering department in the selection of a winged shape building.

This conclusion was so definitely contrary to what appears to be modern building design, especially where air conditioning is provided, that it was decided by the Water Company Board of Directors that further review of this feature, and other less controversial questions, should be made by the Building Planning Service of the National Association of Building Owners & Managers. For carrying on such a review, a panel made up of the following experts in the field of building planning and management was appointed by the Building Planning Service:

George R. Bailey,
Chairman,
Past President of the National Association of Building Owners & Managers; and President, G. R. Bailey & Company, Chicago, a firm specializing in building management.

A. L. Benjamin
Vice President, The Cincinnati Gas & Electric Company.

James F. Cook, Jr.
President, Isaac T. Cook Company, St. Louis, Mo. (Building Management Experts)

F. H. O'Connell
In charge of Building Management Dept. of Klein & Kuhn, Indianapolis realtors.

Earle Schultz
Building Management Consultant, Chicago.

Maynard Hokanson
(Ex-officio)
Manager of Hume-Mansur Building at Indianapolis and Vice President of the National Association of Building Owners & Managers.

Robert B. Beach
(Ex-officio)
Executive Vice President, National Association of Building Owners & Managers, Chicago.

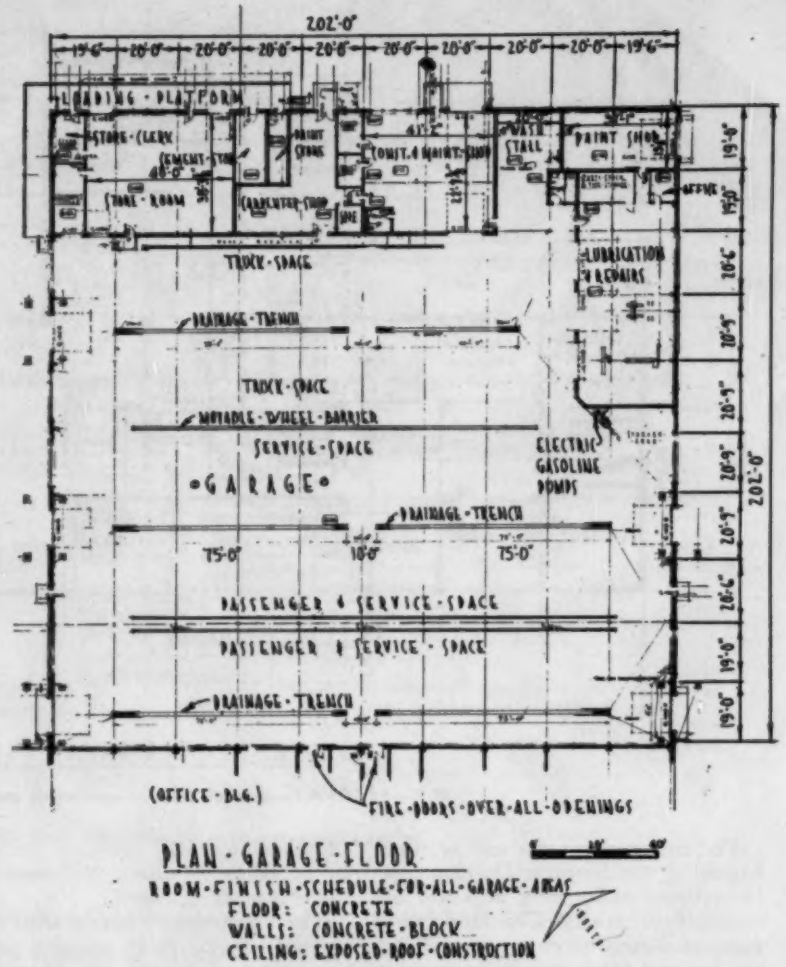
This panel spent two days and far into the intervening night with Water Company officials discussing not only the block versus winged building shape, but also many other features of design. All of the discussions were recorded by a court reporter and the record of these discussions has proven quite valuable in determining details of design and in the selection of building materials. The record is bound and consists of 428 double spaced typewritten 8½ x 11″ sheets.

While there was free discussion among the panel members, only those items were advanced as recommendations upon which there was unanimity of opinion among the panel. Thirty-five recommendations were offered, most of which were adopted. No recommendation was offered relative to the block versus winged controversy since the panel could not reach a unanimous viewpoint. The weight of their opinion, however, was in favor of the block type building.

Having asked the advice of experts, the Water Company, after reconsidering all of the angles, decided not to accept their unexpressed advice, but approved the winged layout which had been developed jointly by the architect and the Water Company engineering staff.

Payment for the review by the panel was upon a per diem plus expense basis. The writers feel that the money was well spent and would not hesitate to advise others in a similar situation to avail themselves of a like service.

The building layout having been approved by the Water Company, the architect was authorized to proceed with the development of detail drawings and specifications.



Pl. 7—GARAGE and shops.

Site Plan

As previously mentioned, the building is located in a large parklike area where it has been possible to provide parking facilities and where future playgrounds can be developed. This site plan (see Plate 2) shows the shape of the building and gives a better idea of the relative size of the office portion and the garage section than can otherwise be obtained.

It will be noted that an employees' parking area has been provided adjacent to the garage. It has a capacity of 127 units. When more space is required, it can be gained by extending this lot.

To the northwest of the garage section and along the railroad siding, but not shown on the drawing, is the pipe storage yard. Fences will be so constructed that all pipe withdrawn from the yards must be driven past the stores clerk who will have his office in the north corner of the garage section.

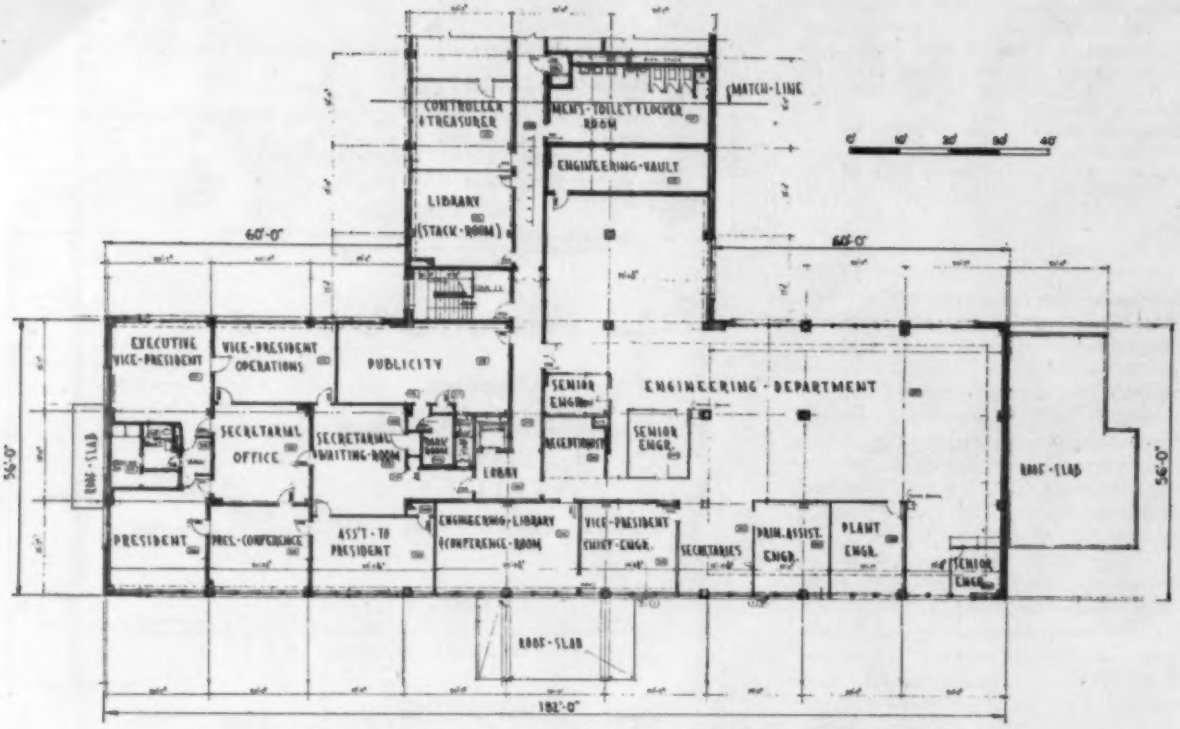
The double driveway with a parkway in the center, which shows at the bottom of the plan, leads to the main Water Company pumping station (Riverside Station). Thus, it can be seen that the Operations Center has been located so that it will be convenient to the other facilities in the area.

First Floor Plan

As stated in the discussion relative to the shape of the building, the floor layout has been very carefully arranged so that the many inter-related functions can be performed with the least lost motion.

On the first floor-front portion of the office building (see Plate 3), the centrally located entrance lobby provides not only a reception and waiting area, but it also constitutes the hub from which the right and left wings and the center stem radiate.

The lobby walls are to be faced with gray marble flecked with garnet. The floor will be of harmonizing terrazo. The front wall of the lobby will be entirely of glass with aluminum trim. At the rear of the lobby and to the left is the wing in which the Purchasing Agent and the Personnel and the Business Development Departments will be located. These are the departments which have the greatest number of outside callers. The Pumping Department, which is located beyond these facilities, has its own private entrance so that the superintendent and his assistant may have ready ingress and egress to the building.



PLAN-SECOND FLOOR FRONT

Pl. 8—SECOND floor front offices—executive and engineering.

The conference room will be used largely by the Business Development Department although it also will be available to others. The conference room also constitutes an area which can be used for expansion, either by the Business Development Department or by the Pumping Department.

It may be noted in looking at the other floor plans of the office section that conference rooms have been provided in all of the wings except the first floor-rear. These will be used as conference rooms in the beginning, but they also can be considered to be locations for future expansion should the areas allocated to the various adjacent departments become too small, or should space have to be provided for new departments.

Assembly-Dining Area

To the right of the lobby will be found the cafeteria and assembly or dining room. The assembly-dining room was decided upon so that, in addition to providing space for company meetings, the company also can accommodate outside groups who may be in need of a meeting place. The facilities of the cafeteria also will be available after working hours to these outside groups should they need them. At the far end of the wing, there is an additional building entrance for use by outsiders to whom the assembly space is made available.

The assembly or dining area can be divided into three separate parts by the use of "Foldoors". Should it be desired, the front end of the assembly room can be closed off by the "Foldoors" and be converted into an employee lounge and rest room. Normally, the assembly room and the area immediately in front of the cafeteria will be used at noon for company employees eating in the building.

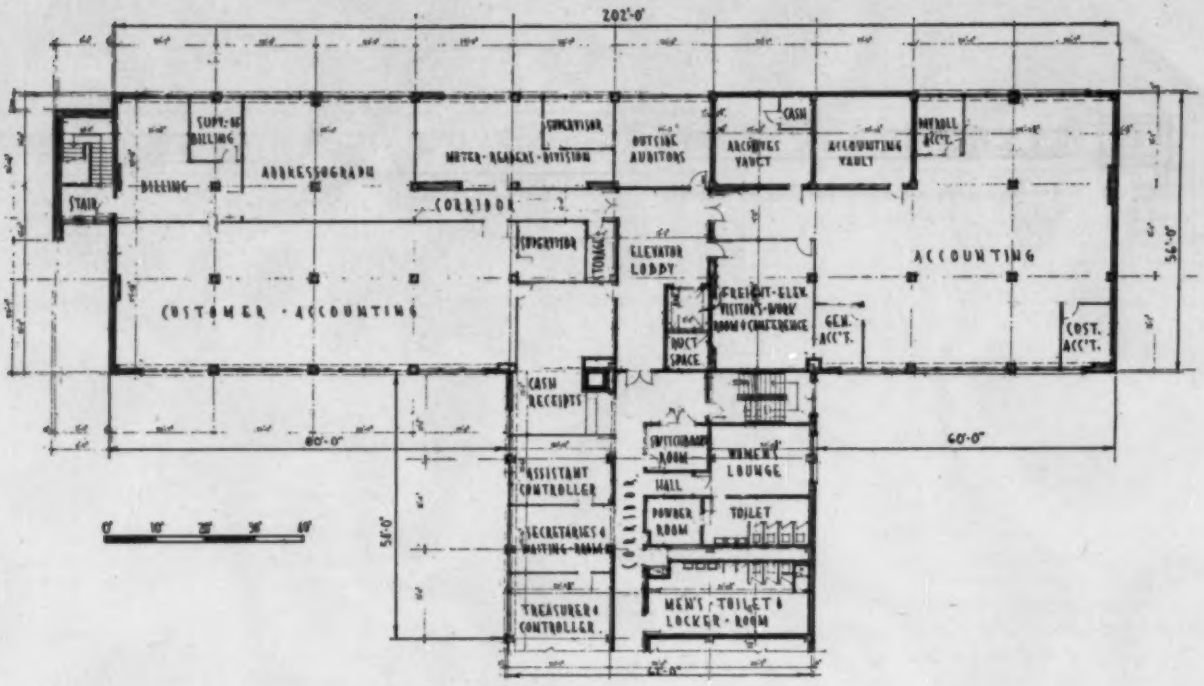
Cafeteria

Considerable study was given to the layout of the cafeteria facilities by the engineering department. When a satisfactory plan was developed, it was turned over to the architect for incorporation in the plans.

The cafeteria and kitchen is being installed in the Center because management feels that it is the company's responsibility to provide adequate wholesome, and tasty food for the employees at the lowest possible cost. The company expects to contract with an outside caterer for the complete operation of these in-office feeding facilities. Under the contemplated contract with the caterer, the Water Company will pay a fixed management fee to the caterer in addition to the operating costs plus a 4 per cent administrative charge. The catering organization being considered operates on a national scale and all of their clients, from whom reports have been received, are most enthusiastic about the effectiveness and economy of their service.

There will be approximately 225 employees in the building, but only about 150 of them will be in the building during the lunch period on a normal day. Of this number, it is anticipated that approximately 110, or about 75 per cent, will make use of the facility. This estimate is based upon the present practice of the Water Company in allowing one hour for lunch. Should the luncheon period be shortened to one-half hour, the number using the cafeteria would increase materially since, in effect, the facility would have a captive clientele, there being no other facilities reasonably close to the Center.

The entire cost of providing the in-office feeding facilities will amount to approximately $32,000. Of this, the installed cost of the kitchen and cafeteria serving equipment will be approximately $12,000. The largest cost item is that of the work to be done



PLAN-SECOND-FLOOR-REAR

Pl. 9—SECOND floor rear offices—accounting and control.

by the general and the two mechanical contractors. This work will amount to approximately $15,000. The balance will be spent for miscellaneous equipment such as pots and pans, silver, china, tables, chairs, and the like.

The kitchen and cafeteria equipment will be faced with stainless steel except the front of the serving counter which will be covered with Formica of a color which will harmonize with the walls in the area.

It is expected that the cafeteria can be operated by three people, a combination manager and cook, a cook's helper, and a dishwasher. The food will be prepared before meal time and, when the employes are being served, the cook and helper will do the serving. It is anticipated that the helper also will serve as cashier.

The detailed layout of the cafeteria and kitchen (Plate 4) has been included primarily to show the relation between the various pieces of equipment and the serving line. There is nothing unique in this layout, but the writers have found very little in the literature available to those experienced in water works rather than in food preparation. It is hoped, therefore, that the information may be of value to such people should they be preparing a cafeteria layout.

Distribution Department

The stem between the front and the rear wings of the first floor together with the front rear wing has been almost entirely given over to the distribution department. (See Plate 5.) The construction and maintenance crews will have a locker room, shower, and toilet facilities provided for them in the right rear wing. This room will be air conditioned as is the rest of the office building, except that the waste exhaust from the balance of that part of the building will be through these areas: In addition, air will be exhausted through the lockers to carry away the odor of wet clothes and to facilitate their drying. A small room also has been provided for drying damp or wet clothes. The laborers, before going home at night, can hang their clothes in this room and have dry clothes to put on in the morning when they go to work.

Many other conveniences have been provided in this part of the building, but only the more important ones have been discussed.

Meter Shop

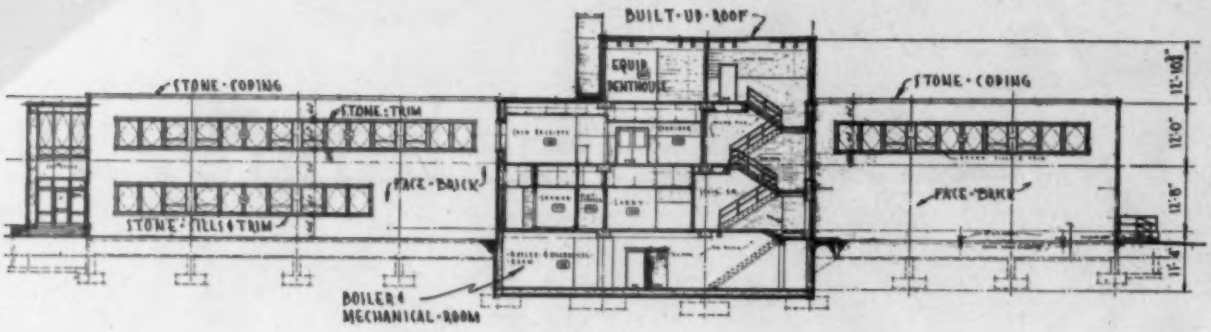
In the left end of the rear wing will be found the meter shop (Plate 5). This shop will be self-contained and on the same floor level as the garage so that each night meters can be loaded upon a cart, wheeled into the garage, and loaded into the servicemen's cars ready for their use the following day.

In the stem between the two buildings is the office area of the distribution department (Plate 6). This area has been presented to show the manner in which the engineering department prepared the functional layout for use by the architect.

One of the features which may be noticed in this arrangement is that there is a separate entrance and waiting room for plumbers who have business with the distribution department. It was felt advisable that this separate facility be provided for them since there are so many plumbers or plumbers' employees who come to the building for one purpose or another that they would present a traffic problem in the main lobby.

Garage & Shops

The large area in the rear of the office building has been divided so that car storage space can be located adjacent to the office building. On the far side of the garage area from



SOUTH-ELEVATION-REAR-WING

Pl. 10—REAR WING—South elevation—shows construction features inside and out.

the building is a storeroom, carpentry shop, mechanical equipment repair shop, and facilities necessary for servicing and repairing the company cars and trucks. (See Plate 7.)

All vehicles will enter the garage area from the left and leave from the right. They will be serviced at night so that the operators can drive them out the first thing in the morning without any delay for servicing.

Second Floor Plan

There is nothing unusual in the arrangement of the departments which are located on the second floor. The left front wing is given over to the executive personnel, and the right to the engineering department. (See Plate 8.)

The second floor rear wing and the stem between the front and rear wings of the second floor are given over to the Accounting Department. (See Plate 9.) There is nothing unusual in the arrangement except that special provisions have been made for outside auditors, engineers, and other persons who must temporarily be provided with work space.

Flexibility

The Water Company, recognizing the desirability of maintaining flexibility in the layout of the various offices, instructed the architect in designing the building (a) to use moveable steel partitions where it might appear that future changes in layout might be desired; (b) to install underfloor duct grids for carrying both power conducters and telephone wires so that electricity and telephone outlets can readily be relocated; and (c) to design the suspended ceiling system so that lighting fixtures can be moved to accommodate the relocation of partitions.

Lighting Given Especial Attention

The lighting design presents something of interest. In the private offices and in the general office areas, recessed fluorescent light fixtures manufactured by "Day-Brite" and equipped with hinged "Holophane" lens assemblies are installed in the suspended acoustical ceilings. The light fixtures and the acoustical material are supported by channels on approximately 4 ft. centers in each direction. Thus, the lighting fixtures can be moved as desired and even turned 90 degrees should the occasion warrant.

The lighting is designed to afford a maintained light intensity of between 40 and 50 foot candles. Where a greater light intensity is desirable, such as in the engineering department drafting room and in the accounting department general office area, the specifications call for the installation of a luminous ceiling. Although there are other satisfactory types of luminous ceilings upon the market, after investigation it was concluded that the type manufactured by the Edwin F. Guth Company, of St. Louis, and referred to by the trade name of "Gratelite" would best suit the needs of this installation.

The "Gratelite" suspended ceiling is made of polystyrene plastic panels in the form of gratings with ⅜-in. square openings throughout. This material is not fireproof but it is classified as "slow burning". Before selecting this type of ceiling, it was determined that its use would not increase the fire insurance premium which otherwise would have to be paid.

While the "Gratelite" panels are supposed to have some sound absorbtive effect, they are not the equal of acoustic tile. Consequently, in areas where "Gratelite" luminous ceilings are used, low grade acoustical material is glued to the structural concrete ceiling.

Fluorescent light tubes (without reflectors) are supported 12 in. above the suspended "Gratelite" ceiling. A maintained lighting level of between 80 and 100 foot candles is anticipated in the areas where luminous ceilings are required. With this type of ceiling, light distribution is such that it is almost impossible to cast a shadow. This characteristic is of particular value in the areas where these luminous ceilings will be used.

Before deciding upon the use of the "Gratelite" ceiling, the architect was asked to make a comparative cost estimate between the "Day-Brite" fixture installed in a ceiling of acoustical tile and the luminous ceiling with the structural ceiling acoustically treated.

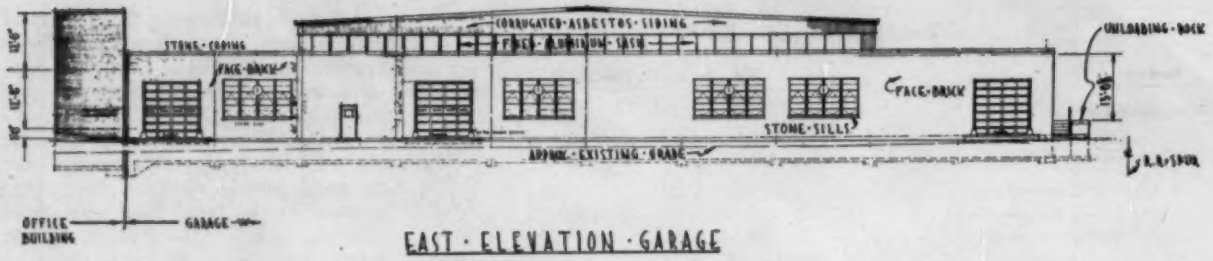
The comparative costs were as follows:

"Gratelite" luminous ceiling cost, complete	$3.81 per sq ft.
"Day-Brite" unit and acoustical panel suspended ceiling	3.76 per sq. ft.

Since the luminous ceiling will yield twice the light intensity with practically no shadows, and will cost only $0.05 per sq. ft. additional, or a total of approximately $700 extra for the entire area proposed for such treatment, it was decided that the extra expense could be justified.

Glazed Tile vs. Painted Plaster

A brief study was made comparing the advantages and relative cost of glazed tile walls versus painted plaster on concrete block. While it was known that the plastered walls would be far cheaper so far as first cost is concerned, it was felt that consideration should be given to the



EAST · ELEVATION · GARAGE

Pl. 11.—GARAGE exterior construction details.

higher maintenance costs associated with the painted plaster. Experience has indicated that it costs approximately $0.07 per sq. ft. to repaint plastered wall, whereas with glazed tile repainting is not required at all. Further, it costs approximaetly $0.03 to wash plaster as compared with $0.01 in the case of tile.

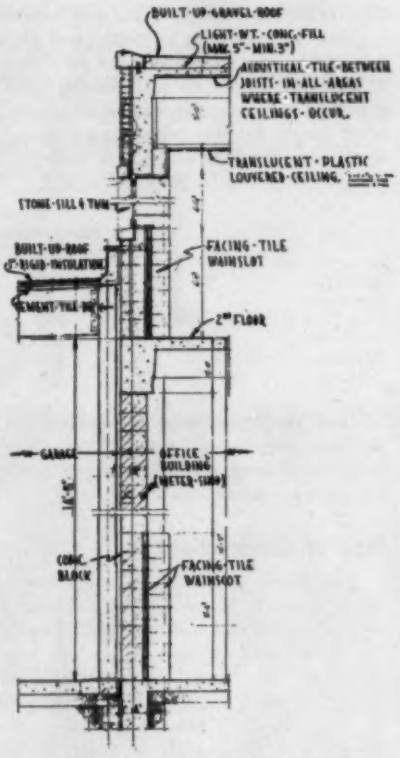
The need for washing or repainting plastered walls above the wainscot height is not great in air conditioned areas, but below that level, except in private offices, the plaster surfaces are subject to more or less marking from soiled hands.

By selecting for tile installation only those walls exposed to frequent contact, and by then applying tile only to wainscot height, the extra first cost of using tile was held to $10,000. This was believed to be a reasonable differential considering the greater maintenance cost required to keep comparable painted surfaces presentable.

Air Conditioning

The office building is to be air conditioned throughout. Management, in deciding to air condition the building, was motivated by a desire to provide for employee comfort and resultant job efficiency. Because of the large volume and type of operations involved, it was felt to be impractical to cool the garage and the shop area. Mechanical ventilation of these areas has been provided, however. The garage proper area will be ventilated by vertical type motorized roof ventilators. The carpenter shop will be ventilated by a wall exhaust fan. The maintenance shops will not be ventilated for normally they are very seldom in use in the summertime.

The cooling effect in the office building, exclusive of the cafeteria and assembly areas, will be accomplished by the operation of an 110-ton refrigeration system of the Trane "CenTraVac" type, together with a well water pre-cooling unit having an equivalent to that of 140 tons of refrigeration. The pre-cooler will be used for pre-cooling the make-up air



WALL SECTION

Pl. 12—TYPICAL wall section in detail.

with well water flowing through a cooling coil. After lowering the temperature of the make-up air the well water will flow to the refrigeration condenser.

The Center is located within a large well field which has a dependable capacity of 10 mgd. One well of this field with a capacity of approximately 350 gpm. will be withdrawn from the city service and be devoted to the Operations Center for supplying the cooling water. The spent water will be returned to the ground in a recharge well which is yet to be drilled. Since the Water Company's wells in this area constitute a reserve and are used very seldom, the loss of 350 gpm. from the city supply will be of little consequence.

In spite of the economy to be effected under the peculiar conditions involved in this installation, the Water Company hesitated to install a non-conserved water cooling system in view of the fact that, in the future, the company likely will attempt to discourage its customers from installing non-water conserved air conditioning systems. However, it was concluded that, in view of the peculiar circumstances, the Water Company would not be establishing an embarrassing precedent.

The cafeteria and assembly room area will be served by a separate self-contained 10-ton year-round air conditioning system. The separate system was planned for this area because use will be made of the cafeteria and assembly room at night and on weekends when the balance of the building will be unoccupied. With this smaller air conditioning system available for use at such times, it will be unnecessary for the larger unit to be operated during the out-of-working-hour light loads.

Heating

The office building will be heated in the wintertime by steam generated in either of two 125 hp. package type oil-fired boilers. Preheated No. 6 oil will be burned in these boilers. They will provide low pressure steam for heating the offices through direct steam radiation installed below the windows and for supplying heating coils installed in the same ducts provided for the cooling air during the summer. The heat supplied through the air conditioning system will constitute approximately 50 per cent of the total.

The garage and shop areas will be

Breakdown of Low Bids*

Item	Bid	Per Sq. Ft.	Per. Cu. Ft.
A. Total Price:			
Office Building	$1,355,000	$18.65	$1.50
Garage & Shops	445,000	10.90	0.56
B. General Construction:			
Office Building	826,000	11.50	0.93
Garage & Shops	285,600	6.74	0.34
C. Mechanical & Electrical:			
Office Building	523,500	7.14	0.57
Garage & Shops	164,900	4.16	0.21

*The breakdown between office and shops is estimated.

heated by vertical type unit heaters supplied with steam from the same two boilers.

Serious consideration was given to making use of the refrigerating equipment as a heat pump during the winter since 55-degree well water is available in such large quantities and, with the electrification of Riverside Station, electricity can be purchased at $0.01 per KWH. It was concluded, however, that it would not be economical or feasible to do this since the heating and cooling cycles are not in balance due to the fact that the large volume of the garage and shop section is not to be cooled in the summer.

Construction Cost of Operations Center

Bids on the construction of the Center were received on April 24, 1956, at a time when contractors were moderately short of work. The total of the three construction contracts amounted to $1,813,382 as compared with the architect's estimate of $1,906,184 and the Indianapolis Water Company estimate of $1,850,000. Other work, such as the construction of driveways, parking lots, landscaping, etc., together with administrative and overhead charges, interest during construction, and engineering and contingencies, will bring the total project cost, exclusive of furniture and equipment, to $2,300,000.

Herewith, a comparison of the low and high bids:

Bid Variation

Contract	Bidders	Low Bid	High Bid	Difference	Percent
General	6	$1,106,000	$1,169,000	$63,000	5.7
Heating, Plumbing, & Air Conditioning	5	361,163	398,633	37,470	10.4
Electrical	5	346,219	369,068	22,849	6.6
Totals		$1,813,382	$1,936,701	$123,319	

When the bids were taken, the ENR building cost index was 487.4 as compared with 100 in 1913.

Also, herewith, a tabulation of the prevailing union wage rates in effect at the time the bids were being prepared. There may have been an allowance made by the contractors, however, for an anticipated increase which became effective on June 1:

Job	Hourly Rate
Brick Mason	$3.45
Carpenter	3.10
Electrician	3.25
Hod Carrier	2.32
Iron Worker	3.15
Plasterers	3.25
Laborers	2.15

The accompanying breakdown of the low bids should prove interesting to those making preliminary estimates for similar work.

Type of Construction

The basic structure of the Operations Center is of 3,000 lb. ready mixed reinforced concrete with beams on 20-ft. centers and joists on 3-ft. centers. The floor system has been designed for a loading of 125 lbs. per sq. ft., including the weight of partitions. The floor slab is 5 in. thick. Generally the building is faced with brick and the trim is native Indiana limestone.

The wall construction and concrete framing may be seen by reference to the section included on the elevation of the rear wing, (Plate 10) and on the wall section shown on Plate 12. In addition to showing the structural construction, the wall section shows the general manner in which the luminous ceiling is installed on the second floor.

On Plate 11, the relation between the office section and the garage may be seen. The monitor on the garage section will be faced with corrugated asbestos siding. The windows will be fixed and made with aluminum frames.

The monitor has been used to enclose truss construction which spans from column supports at each end. The low section of the garage roof which shows on the left between the monitor and the office building is supported by steel I-beams. This section is part of the open garage. On the right, the low roof is supported in the same manner, but the area devoted to the shops and the storeroom is separated from the garage area by a concrete block wall at the column line.

Acknowledgements

The general plans and specifications were prepared by the architectural firm of Daggett, Naegele & Daggett. Associated with them in connection with the structural design is the engineering firm of Fink, Roberts & Petrie.

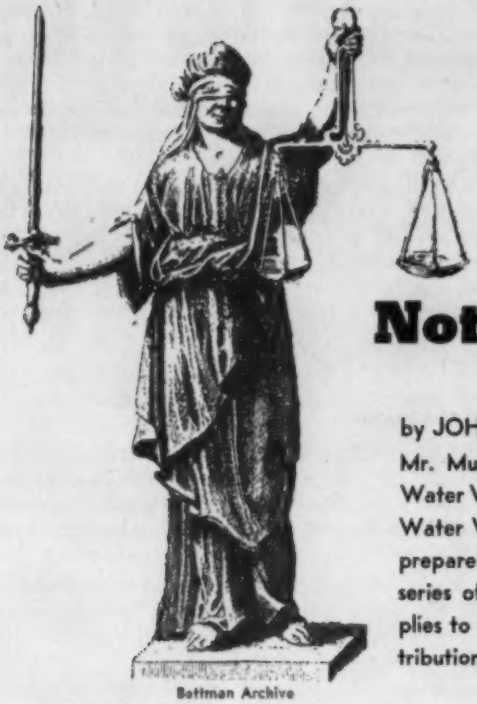
The mechanical engineering work has been done by the firm of Ammerman, Davis & Stout in association with the architects.

The general contract work is being done by the Wm. P. Jungclaus Company; the plumbing, heating, and air conditioning by Freyn Brothers, Inc.; the electrical work by Long Electric Company.

The Water Company management team is composed of H. S. Morse, Chairman of the Board, T. W. Moses, President of the Company, and D. P. Morse, Executive Vice President.

Acknowledgement is given to the heads of the Water Company departments which are to be housed in the Operations Center, Messrs. Swingley, Niemeyer, Crabill, and Coughlen, for their assistance in developing the functional plans; to Mr. O. W. Summers, Plant Engineer, for his work in connection with the development of the mechanical and electrical layouts and the selection of the mechanical equipment; and to the many other members of the Water Company engineering staff, who have cooperated with the authors before and during construction of the Center.

To Mr. J. E. Kleinhenz, the authors express their appreciation for supplying the photographs and other assistance given in the preparation of this article.



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Notes on Water Works Law

by JOHN H. MURDOCH, JR.*

Mr. Murdoch, retired Vice-President of American Water Works Co., Inc., and Chief Counsel of American Water Works Service Co., Inc., Philadelphia, Pa., has prepared exclusively for *Water & Sewage Works* this series of articles discussing water works law as it applies to source of supply, water quality, and water distribution.

11th Installment

Water Works Liability To Property Owners for Fire Losses

IN THIS INSTALLMENT of Notes on Water Works Law consideration is directed to several related questions.

Q—The first of these questions is whether fire protection service rendered by a municipality is a proprietary or governmental function.

A—The answer is that it is a governmental function. This appears to be the universal holding and no citation of authorities need be set forth. It should be noted that, while water service to the public for general service if rendered by a municipality, has been held to be a proprietary function, as was pointed out in earlier installments, the courts hold that providing water for fire protection by means of a municipally owned and operated system is a government function.

Q—The next question then arises: Is a municipality liable for fire losses occasioned by its failure to render proper and adequate water service for fire protection.

A—The courts hold that since fire protection is a govmental function the municipality cannot be held liable for fire losses suffered by property owners although the approximate cause of the loss was the failure of the authorities to render adequate service. This is certainly the rule where the loss is due to a failure to act, as for illustration, a failure to provide adequate pressure or volume of water because of inadequate mains. Some court opinions contain language which might be held to indicate the thought that a positive act of misfeasance on the part of municipal officials which act leads to a fire loss would involve the municipality in liability. Thus it might be that there would be liability for damage if, during a fire, an employee of the municipality negligently shut down an essential pump or closed a main line valve thus cutting off what would otherwise have been an adequate fire flow. No cases have been found directly in point, which is evidence of the general competence of municipal water works employees.

Q—The third question concerns the liability of a private water company rendering public fire service under a contract with the municipality. Can a property owner recover damages for fire losses traceable to failure of the water company to render the service called for by its contract with the municipality?

A—In Kentucky, North Carolina and Florida the answer of the courts is in the affirmative. In at least twenty-seven other states the courts have answered in the negative. The majority opinions hold that individual property owners or citizens are not parties to the contract between the municipality and water company—

*Mr. Murdoch, having reached the mandatory retirement age under the retirement plan of the American Water Works Co., Inc., retired on Dec. 1, 1956. He intends to remain active in the fields of water works law and water works management.

there is no privity of contract between the individual and the company—and that the individual cannot recover damages for breach of a contract to which he is not a party. The three states of Kentucky, North Carolina and Florida to the contrary hold that the contract was made for the benefit of the individuals and that they are parties to it although not named or mentioned. Essentially they are held—in the three named states—to be third party beneficiaries and as such entitled to bring suit for breach of the contract.

Q—The next question is whether the private company can be liable for damages on the ground of negligence—through an action in tort—for failure to render the degree of service called for by the contract or by the circumstances.

A—Here the majority rule is that there is no such liability since there is no legal duty on the part of the water company to protect individuals and, without a duty to act, there can be no liability for failure to act. There have been no cases found directly on the point but it may well be that a positive act of misfeasance which cuts off or curtails a fire stream known to be in use would render the negligent company liable for resulting fire loss. No cases have been found and, again, this indicates a high degree of care in operation.

Q—Another question is whether the individual property owner may recover for his loss through fire on the ground that the water company had failed to meet the standard of service established under the various state public utility statutes.

A—The courts have held that such statutes in this regard merely declare the common law and since under the common law the company has neither privity of contract with the individual nor duty toward him as an individual for fire service, the public utility statutes do not create a liability.

Q—If and when the state law opens the door to legal liability where is the burden of proof?

A—The courts have made it clear that there can be no recovery of damages for fire losses from a water company unless the proof is that the dereliction or negligence of the water company was the proximate cause of the injury. Thus in the case of Mountain Water Co. v. Davis, 241 Southwestern Reporter, 801, a case in Kentucky which permits suits by individuals under the municipal-water company contract, a retrial was ordered on the basis of faulty court instructions to the jury, where there were indications that poor fire fighting equipment and unskilled firemen were the proximate cause of the loss rather than water company failure of supply. Thus, even in the three dissenting states it has been held that the water company is not an "insurer" against fire loss but is only liable where its failure was the proximate cause of the loss.

In the cases which follow attention should be given to the reasoning of the courts in reaching the majority rules as above stated. Attention should also be given to the practical considerations which appear to have been somewhat influential in leading the courts to what may appear to be highly technical legal points. It must not be overlooked, when one is inclined to sympathy for the property owner, that he has or can have adequate insurance coverage from companies whose business it is to assume such risks and that, if recovery be permitted, the insurance companies would usually be the beneficiaries. Further, it must be remembered that the weaknesses of water works systems are within the range of knowledge of municipal officials and of fire underwriters and that correction of weaknesses can be readily brought about either through court or commission action. Neither municipally nor privately owned water works systems hold themselves out as able at all times and under all conditions to offer fully adequate fire protection service. Where better protection is demanded and paid for it can be made available. Under ordinary circumstances reasonably adequate service is all that is held out.

Only a few illustrative cases setting forth the majority rule will be cited. There are scores of such cases but only enough are quoted to bring out the reasoning of the writers of the opinions.

The first case cited is from Indiana and sets forth the common law rule but also takes up the claim that the public utility law so changed the situation as to make the water company liable.

Citation of Authorities

TRUSTEES OF JENNIE DePAUW MEMORIAL METHODIST EPISCOPAL CHURCH, Appellant v. NEW ALBANY WATER WORKS. Indiana Supreme Court, June 26, 1923. 140 N.E. 540; 27 American Law Reports 1274.

Church was destroyed by fire and trustees brought suit against the water company claiming damages were caused by negligent failure of company to maintain fire hydrants in condition for use.

Demurrer sustained. Judgment for the water company. Trustees appealed. Supreme Court of Indiana affirmed the lower court judgment.

The court said, inter alia,

"Under the common law as interpreted by this court, sustained by a formidable line of authorities, neither a municipality operating its own waterworks, nor a privately owned company serving a city and its inhabitants with water for domestic purposes and for the purpose of extinguishing fires, is liable in damages to any individual for a loss from fire occasioned by the failure to obtain water from fire hydrants to extinguish such fire. (citing cases) * * *

"Appellant in its complaint declares in tort for the violation of an alleged statutory duty. In order for the complaint to be well founded upon this contention it would be necessary to hold that such statutory duty, if there could be one under the statute, flows to the individual, the appellant in this case. As a foundation for the holding in this class of cases prior to the law regulating public utilities, it was declared that a private citizen was not privy to the contract between the utility company and the municipality, and *that no duty was owed to him in his individual capacity to provide him with water to prevent the destruction of his property by fire.* (Emphasis added by present writer.) * * * So that it is necessary to hold under the Public Service Act that appellee owed no contractual duty for such service to the appellant.

"Appellant seeks to construe its own complaint to sound in tort, which involves the rule of law that, to make the appellee guilty of negligence against the appellant, it must have owed a duty to appellant, which duty it has violated. There having been no contractual relationship between the parties and it now being held that the statute (Note Public Service Act) is merely declaratory of the common law and that it does not impose a statutory duty upon the appellee to render such service directly to appellant, its complaint has no standing as being delictual. * * * No one has a right to damages, occasioned by injury, for an injury unless there is some person who is legally answerable for having caused the injury for 'negligence will not be a ground for legal

liability unless the party whose conduct is in question is already in a situation that brings him under the duty 'of taking care.' Pollock, Torts, 10th ed. chap. XI. In other words, in order to create a right to damages, two things must concur: That the one claiming the damages has suffered an injury and that someone is legally answerable for having caused it. * * * no duty is cast upon the water company to furnish water for extinguishing fires in behalf of any individual * * * but only to the municipality, no actionable wrong was committed against the appellant."

The case of German Alliance Insurance Company *v.* Home Water Supply Company must be cited first because it is a United States Supreme Court decision upholding the majority rule of non-liability but also because it explains away the earlier case of Fisher, 200 U.S. 57, which is often cited in support of the minority position.

GERMAN ALLIANCE INSURANCE CO. v. HOME WATER SUPPLY CO. No. 19. Argued April 26, 1912. Decided December 2, 1912. 226 U.S. 220.

"* * * 'The Spartan Mills' owned a number of houses in Spartanburg, South Carolina. They were damaged by fire on March 25, 1907. The German Alliance Company, which had insured the buildings, paid $68,000, the amount of the loss, took from the mills an assignment of all claims and demands against any person arising from or connected with the loss or damage,' and brought suit, in the United States Court for the District of South Carolina, against the Home Water Supply Company, on the ground that the fire could easily have been extinguished and the damage prevented if the Water Company had complied with its contract and duty to furnish the inhabitants of the city with water for fire protection.

"* * * *"

From the Opinion:

"The courts have almost uniformly held that municipalities are not bound to furnish water for fire protection. Such was the unquestioned rule when they relied, as some still do, on wells and cisterns as a source of supply; nor was there any increase of liability with the gradual increase of facilities—though, with the introduction of reservoirs, standpipes, pumping stations and steam engines, cities were frequently sued for damages resulting from an indaquate supply or insufficient pressure. But the city was under no legal obligation to furnish the water; and if it voluntarily undertook to do more than the law required, it did not thereby subject itself to a new or greater liability. It acted in a governmental capacity, and was no more responsible for failure in that respect than it would have been for failure to furnish adequate police protection.

"If the common law did not impose such duty upon a public corporation, neither did it require private companies to furnish protection to property reached by their pipes. And there could, of course, be no liability for the breach of a common law, statutory or charter duty which did not exist. It is argued, however, that even if, in the first instance, the law did not oblige the company to furnish property owners with water, such a duty arose out of the public service upon which the defendant entered. But if, where it did not otherwise exist, a public duty could arise out of a private bargain, liability would be based on the failure to do or to furnish what was reasonably necessary to discharge the duty imposed. The complaint proceeds on no such theory. It makes no allegation that the defendant failed to furnish a plant of reasonable capacity, or neglected to extend the pipes where they were reasonably required. Nor is it charged that what the company actually did was harmful in itself or likely to cause injury to others, so as to bring the case within the principle applicable to the sale of unwholesome provisions, or misbranded poisons which, in their intended use, would be injurious to purchasers from the original vendee. So that, notwithstanding numerous charges of culpable, wanton and malicious neglect of duty, this suit—whether regarded as *ex contractu* or *ex delicto*—is for breach of the provisions of the contract of February 14, 1900, which must, therefore, be the measure of plaintiff's right and of the defendant's liability.

"Whether a right of action arises, out of such a contract, in favor of a taxpayer is a matter about which there has been much discussion and some conflict in decisions. Although for nearly a century it has been common for private corporations to supply cities with water under this sort of agreement, we find no record of a suit like this prior to 1878, when the Supreme Court of Connecticut, in a brief decision (Nickerson v. Hydraulic Co., 46 Connecticut, 24), held that the property owner was a stranger to the agreement with the municipality, and, therefore, could not maintain an action against the company for a breach of its contract with the city. Since that time similar suits, some in tort and some for a breach of the contract, have been brought in many other States. In view of the importance of the question, the subject has been examined and reexamined, the contract subjected to the most critical analysis and many elaborate opinions have been rendered. They are cited in 3 Dillon Munic. Corp., Sec. 1340, and in Ancrum v. Water Co., 82 S. Car. 284.

"From them it appears that the majority of American courts hold that the taxpayer has no direct interest in such agreements and, therefore, cannot sue *ex contractu*. Neither can he sue in tort, because in the absence of a contract obligation to him, the water company owes him no duty for the breach of which he can maintain an action *ex delicto*. * * *

"The result is that plaintiff cannot maintain this action, and though based upon the general principle that the parties to a contract are those who are entitled to its rights, is in accordance with the particular intent of those who made this agreement.

"If the company had, indeed, made a valid contract for the benefit of a third person, the amount of the damages for which it might be liable would be immaterial. Yet where there is no such express agreement, and liability to a taxpayer is sought to be raised by implication, it is proper to test the correctness of the proposed construction by noting the results to which it would lead. The contract was made in February, 1900. By its terms the city was, during a period of 10 years, to pay $40 per annum for each hydrant. During that time the property subject to damage by fire might double or quadruple in value. The failure to provide that the water rent of $40 per hydrant should rise or fall with the increase or decrease in such values indicates that liability for damage to that property was not in the contemplation of the parties and that no payment therefore was included in the price for each hydrant. Otherwise the amount of payment would naturally have varied with the risk assumed.

"In some States it is held that, in the absence of a statute, a city can neither directly nor indirectly make a contract with a water company that the latter should pay private individuals for fire damage, since that would involve the use of public money to secure a private benefit to the owner of private property. *Hone v. Water Co.*,

140 Maine, 217. In *Ancrum v. Water Co., supra,* the South Carolina court held that the amount paid per hydrant was so insignificant by comparison with the enormous risk involved, as clearly to indicate that neither the city nor the water company intended that the latter should be liable to the taxpayer for a breach of the company's contract with the city.

" This conclusion deprives the property owner of no right, for if the city had owned the works, and had been guilty of the same acts as are charged against the water company here, no suit could have been maintained against the municipality. There was no creation of a right to fire protection if, instead of doing so itself, the city contracted with a private company to furnish water. It bought the citizen no new right of action, and did not bargain to secure for him an indemnity against loss by fire, but left him to protect himself against that hazard by insurance, paying the premium direct to an insurance company instead of indirectly through taxation. When, in pursuance of such precaution, the Spartan Mills insured the houses, and plaintiff later settled the fire loss, there was no right of action in favor of the manufacturing company against the Water Company to which the Insurance Company could be subrogated.

"The plaintiff urges that, whatever the rule elsewhere, it is entitled to recover under the decision in *GUARDIAN TRUST CO v. FISHER,* 200 U.S. 57. But the facts there differ from those in this record. There the water company had an exclusive right, to use the streets in the city of Greensboro, under an ordinance which, among other things, provided that 'said water company shall be responsible for all damage sustained by the city, or any individual or individuals, for any injury sustained from the negligence of the said company, either in the construction or operation of their plant.' (p. 58.) Buildings were destroyed as a result of the negligent failure of the company to furnish sufficient water while operating its plant. The owner brought suit against the water company in the courts of North Carolina, where it had previously been settled that such actions could be maintained. He recovered a judgment 'for the tortious injury and damage done to the plaintiff by the negligence of the defendant.' 128 No. Car. 375; 115 Fed. Rep. 187. Execution issued, but no levy could be made, because the property of the water company was in possession of a receiver, appointed in foreclosure proceedings pending in the United States court. The plaintiff intervened therein, claiming that he was entitled to be paid before the bond-holders by virtue of the North Carolina statute, which provided that 'judgments for corporate torts' should take priority over older mortgages.

"It was urged, among other things, by the bondholders that the suit in the state court was really for breach of contract, and that entering the judgment as for a tort did not change the nature of the action so as to entitled the plaintiff to be benefits of the North Carolina statute.

"It was that question alone, as to the character of the suit and judgment, which was before this court. What was said in the opinion must be limited, under well-known rules, to the facts and issues involved in the particular record under investigation. The *Fisher Case* could not have decided the primary question as to the right of the taxpayer to sue, for that issue had been finally settled by the state court. It raised no Federal question and was not in issue on the hearing in this court. Neither did the *Fisher Case* overrule the principle, announced in *National Bank v. Grand Lodge,* 98 U.S. 123,

124, that a third person cannot sue for the breach of a contract to which he is a stranger unless he is in privity with the parties and is therein given a direct interest. The judgment of the Circuit Court of Appeals is Affirmed."

The case of Moch Co., Inc., v. Rensselaer Water Company deserves careful study not only because it sets forth the majority position precisely but because the opinion was written by Cardozo, C.J. He later became a justice of the United States Supreme Court and throughout his judicial career was recognized as a painstaking, brilliant and liberal judge. It is of interest to note that Chief Justice Vanderbilt in his dissent in the Reimann case, which is later referred to, made reference to Cardozo in such a way as, doubtless unintentionally, to give the impression that Cardozo did not favor the majority rule. This Moch case opinion proves that he did lend his support to that rule.

H. R. MOCH CO., INC., v. RENSSELAER WATER CO., Court of Appeals of New York. Jan. 10, 1928. 159 N.E. 896.

"* * * *CARDOZO, C. J.* The defendant, a waterworks company under the laws of this state, made a contract with the city of Rensselaer for the supply of water during a term of years. Water was to be furnished to the city * * * and for service at fire hydrants, the latter service at the rate of $42.50 a year for each hydrant. * * * While this contract was in force, a building caught fire. The flames, spreading to the plaintiff's warehouse near by, destroyed it and its contents. The defendant, according to the complaint, was promptly notified of the fire, 'but omitted and neglected after such notice, to supply or furnish sufficient or adequate quantity of water, with adequate pressure to stay, suppress, or extinguish the fire before it reached the warehouse of the plaintiff, although the pressure and supply which the defendant was equipped to supply and furnish, and had agreed by said contract to supply and furnish, was adequate and sufficient to prevent the spread of the fire to and the destruction of the plaintiff's warehouse and its contents.' By reason of the failure of the defendant to 'fulfill the provisions of the contract between it and the city of Rennsselaer,' the plaintiff is said to have suffered damage, for which judgment is demanded. A motion, in the nature of a demurrer, to dismiss the complaint, was

denied at Special Term. The Appellate Division reversed by a divided court."

* * *

"[1,2] (1) We think the action is not maintainable as one for breach of contract.

" No legal duty rests upon a city to supply its inhabitants with protection against fire. That being so, a member of the public may not maintain an action * * * against one contracting with the city to furnish water at the hydrants, unless an intention appears that the promisor is to be answerable to individual members of the public as well as to the city for any loss ensuing from the failure to fulfill the promise. No such intention is discernible here. On the contrary, the contract is significantly divided into two branches: One a promise to the city for the benefit of the city in its corporate capacity, in which branch is included the service at the hydrants; and the other a promise to the city for the benefit of private takers, in which branch is included the service at their homes and factories. In a broad sense it is true that every city contract, not improvident or wasteful, is for the benefit of the public. More than this, however, must be shown to give a right of action to a member of the public not formally a party. The benefit, as it is sometimes said, must be one that is not merely incidental and secondary. * * * It must be primary and immediate in such a sense and to such a degree as to bespeak the assumption of a duty to make reparation directly to the individual members of the public if the benefit is lost. The field of obligation would be expanded beyond reasonable limits if less than this were to be demanded as a condition of liability. A promisor undertakes to supply fuel for heating a public building. He is not liable for breach of contract to a visitor who finds the building without fuel, and thus contracts a cold. The list of illustrations can be indefinitely extended. The carrier of the mails under contract with the government is not answerable to the merchant who has lost the benefit of a bargain through negligent delay. The householder is without a remedy against manufacturers of hose and engines, though prompt performance of their contracts would have stayed the ravages of fire. 'The law does not spread its protection so far.' * * *

"So with the case at hand. By the vast preponderance of authority, a contract between a city and a water company to furnish water at the city hydrants has in view a benefit to the public that is incidental rather than immediate, an assumption of duty to the city and not to its inhabitants. Such is the ruling of the Supreme Court of the United States. German Alliance Ins. Co. v. Homewater Supply Co. * * * Such has been the ruling in this state, * * * though the question is still open in this court. Such with few exceptions has been the ruling in other jurisdictions. Williston, Contracts, Sec. 373, and cases there cited; Dillon, Municipal Corporations (5th Ed.) Sec. 1340. The diligence of counsel has brought together decisions to that effect from 26 states. * * * Only a few states have held otherwise. Page, Contracts, Sec. 2401. An intention to assume an obligation of indefinite extension to every member of the public is seen to be the more improbable when we recall the crushing burden that the obligation would impose. * * * The consequences invited would bear no reasonable proportion to those attached by law to defaults not greatly different. * * * If the plaintiff is to prevail, one who negligently omits to supply sufficient pressure to extinguish a fire started by another assumes an obligation to pay the ensuing damage, though the whole city is laid low. A promisor will not be deemed to have had in mind the assumption of a risk so overwhelming for any trivial reward."

* * *

"[3] (2) We think the action is not maintainable as one for a common-law tort.

" 'It is ancient learning that one who assumes to act, even though gratuitously, may thereby become subject to the duty of acting carefully, if he acts at all.' * * * The plaintiff would bring its case within the orbit of that principle. The hand once set to a task may not always be withdrawn with impunity though liability would fail if it had never been applied at all. A time-honored formula often phrases the distinction as one between misfeasance and nonfeasance. Incomplete the formula is, and so at times misleading. Given a relation involving in its existence a duty of care irrespective of a contract, a tort may result as well from acts of omission as of commission in the fulfillment of the duty thus recognized by law. Pollock, Torts (12th Ed.) p. 555; Kelly v. Metropolitan Ry. Co., (1895) 1 Q.B. 944. What we need to know is not so much the conduct to be avoided when the relation and its attendant duty are established as existing. What we need to know is the conduct that engenders the relation. It is here that the formula, however incomplete, has its value and significance. If conduct has gone forward to such a stage that inaction would commonly result, not negatively merely in withholding a benefit, but positively or actively in working an injury, there exists a relation out of which arises a duty to go forward. Bohlen, Studies in the Law of Torts, p. 87. So the surgeon who operates without pay is liable, though his negligence is in the omission to sterilize his instruments (cf. Glanzer v. Shepard, supra); the engineer, though his fault is in the failure to shut off steam (Kelly v. Metropolitan Ry. Co., supra); cf. Pittsfield Cottonwear Mfg. Co. v. Pittsfield Shoe Co., 71 N.H. 522, 529, 533, 53 A. 807, 60 L.R.A. 116); the maker of automobiles, at the suit of some one other than the buyer, though his negligence is merely in inadequate inspection (MacPhearson v. Buick Motor Co., 217 N.Y. 382, 111 N.E. 1050, L.R.A. 1916F, 696, Ann. Cas. 1916C, 440). The query always is whether the putative wrongdoer has advanced to such a point as to have launched a force is at most a refusal to become an instrument for good. Cf. Fowler v. Athens City Water Works Co., 83 Ga. or instrument of harm, or has stopped where inaction 219, 222, 9 S.E. 673, 20 Am. St. Rep. 313.

"The plaintiff would have us hold that the defendant, when once it entered upon the performance of its contract with the city, was brought into such a relation with every one who might potentially be benefited through the supply of water at the hydrants as to give to negligent performance, without reasonable notice of a refusal to continue, the quality of a tort. * * * We are satisfied that liability would be unduly and indeed indefinitely extended by this enlargement of the zone of duty. The dealer in coal who is to supply fuel for a shop must then answer to the customers if fuel is lacking. The manufacturer of goods, who enters upon the performance of his contract, must answer, in that view, not only to the buyer, but to those who to his knowledge are looking to the buyer for their own sources of supply. Every one making a promise having the quality of a contract will be under a duty to the promisee by virtue of the promise, but under another duty, apart from contract, to an indefinite number of potential beneficiaries when performance has begun. The assumption of one relation will

mean the involuntary assumption of a series of new relations, inescapably hooked together. Again we may say in the words of the Supreme Court of the United States, 'The law does not spread its protection so far.' * * * We do not need to determine now what remedy, if any, there might be if the defendant had withheld the water or reduced the pressure with a malicious intent to do injury to the plaintiff or another. We put aside also the problem that would arise if there had been reckless and wanton indifference to consequences measured and foreseen. Difficulties would be present even then, but they need not now perplex us. What we are dealing with at this time is a mere negligent omission, unaccompanied by malice or other aggravating elements. The failure in such circumstances to furnish an adequate supply of water is at most the denial of a benefit. It is not the commission of a wrong.

"[4] (3) We think the action is not maintainable as one for the breach of a statutory duty.

"The defendant, a public service corporation, is subject to the provisions of the Transportation Corporations Act. The duty imposed upon it by that act is in substance to furnish water, upon demand by the inhabitants, at reasonable rates, through suitable connections at office, factory, or dwelling, and to furnish water at like rates through hydrants or in public buildings upon demand by the city, all according to its capacity. * * * We find nothing in these requirements to enlarge the zone of liability where an inhabitant of the city suffers indirect or incidental damage through deficient pressure at the hydrants. The breach of duty in any case is to whom service is denied at the time and at the place where service to such one is due. The denial, though wrongful, is unavailing without more to give a cause of action to another. We may find a helpful analogy in the law of common carriers. A railroad company is under a duty to supply reasonable facilities for carriage at reasonable rates. It is liable, generally speaking, for breach of a duty imposed by law if it refuses to accept merchandise tendered by a shipper. The fact that its duty is of this character does not make it liable to some one else who may be counting upon the prompt delivery of the merchandise to save him from loss in going forward with his work. If the defendant may not be held for a tort at common law, we find no adequate reason for a holding that it may be held under the statute.

"The judgment should be affirmed, with costs."

The next case is cited because it presents an instance of misfeasance. Note that it was an electric company rather than a water company which was held to be at fault. No similar water system case has been found.

HIGHWAY TRAILER CO. v. JAMESVILLE ELECTRIC CO., 190 Northwestern Reporter, 110. Supreme Court of Wisconsin. Oct. 10, 1922.

From the Complaint:

"* * * That after the starting of the fire and while the fire department was engaged in subduing and controlling the said fire and had the same under control and confined to a comparatively small area so using the pressure as developed and maintained by the defendant's electric current, the defendant negligently, at about 1:15 a.m., caused the electric current to be cut off on its lines to the city of Edgerton at the main plant in Janesville, and remained so discontinued for the space of three-fourths of an hour, during which period defendant cut the primary wires on one of the poles in the pole line between plaintiff's plant and the pumping station. That there was no necessity or occasion for the cutting of the wires or the suspending of service as was then known to defendant's local manager and servants. That such cutting of the primary wires was carelessly and negligently done and much more time used in so doing than was necessary in the exercise of ordinary care and by reason of such unnecessary interruption of the service the fire progressed beyond the control of the fireman. * * *"

From the Opinion:

"* * * From the allegations of this complaint as summarized in the statement of facts we can see sufficient to support the conclusion that there is alleged, not merely a breach of defendant's contract with the city of Edgerton, but a breach of the obligation which the defendant, as well as all persons, owed to the plaintiff, as well as to all other residents of the city to whom at any time the city of Edgerton might be in the immediate performance of its governmental function of fire protection to not interfere with such gratuitous and voluntarily assumed function by the city, and that any breach of such implied duty so resting on defendant and all third persons by any intentional, unwarranted, or negligent interference with or caused interruption of such service may be considered a tort, and for the damages proximately caused thereby the person responsible for the same be held liable.

"We consider therefore that the obligations tending to show defendant's intentional, unnecessary interruption of and interference with the service being rendered to plaintiff by the city in extinguishing the fire brings this case squarely within the rule and doctrine stated in the case of Concordia F.I. Co. v Simmons, 167 Wis., 546, N.W. 199, where the defendant, while driving piles for a building on its own premises broke into the main water supply pipes of the city of Kenosha and interrupted its service in fire protection. * * *"

The last case in point which has come to the attention of the writer is the New Jersey case of Reimann v. Monmouth Consolidated Water Co. The Chief Justice filed a long, vigorous dissenting opinion against the majority of his court which had followed the prior decisions of non-liability. This dissent is based essentially on the ground that the company "held itself out" as supplying water for fire protection and the reliance of the public on such holding out. The present writer doubts that there is such holding out or reliance as conceived of by Justice Vanderbilt.

"SUPREME COURT OF NEW JERSEY. No. A-73 September Term 1951; 9 N. J.R. 134. *HERMAN REIMANN v. MONMOUTH CONSOLIDATED WATER COMPANY."*

The opinion of the Court was delivered by

Case, J. "Plaintiff suffered a fire loss said to have been due to lack of water and pressure at fire hydrants served by the defendant water company. He instituted action by a complaint which defendant attacked upon the ground that it did not state a claim upon which relief could be granted. On motion the court rendered judgment for the defendant. This appeal brings up that judgment.* * *

"The complaint contained three counts, all souding in tort. The first count charged that the water company, by reason of the matters briefly reviewed above, represented that water would be supplied at the hydrants

in reasonable volume and pressure for the extinguishment of fires in business structures such as plaintiff's and thereby induced reliance thereon by plaintiff and others and also thereby, to defendant's knowledge, induced the township to make no other provision for a supply of water, that defendant thereby assumed and owed to plaintiff a correlative duty of reasonable care to prevent the type of harm suffered by plaintiff; that defendant breached its duty in that prior to and at the time of the fire, and especially after knowing of the outbreak of the fire, defendant failed to supply a sufficient volume of water or pressure at the hydrants for the ordinary purposes of those hydrants; this, notwithstanding the company had notice by reason of a fire a few weeks earlier that the volume and pressure of water at hydrants in the vicinity were insufficient and that plaintiff's property loss was approximate result of the company's negligence. It is not to be understood that the complaint charged the company with making an actual representation in manner above set forth; it merely alleged the pleader's conclusion that the congeries of facts which we have related amounted to a representation. The count was intended to ground in nonfeasance.

"The second count was pleaded as a misfeasance. It amplified the charge of negligence by alleging that the company, although it knew of the existence of a volunteer fire department and of the reliance of the department in case of fire upon an adequate supply of water, had, several hours before plaintiff's fire, so controlled the water-supply mechanism that there was not a sufficient volume of water or pressure, and that although informed of the fire at the outbreak permitted two hours to pass before providing proper quantity and pressure, and that in consequence of plaintiff's reliance upon defendant's due performance of its duty and of defendant's disregard thereof the property losses were incurred. At the argument it was conceded that the reduction of quantity and pressure was a regular daily practice following the peak load of the day and had no purposeful connection with the conflagration. * * *

"Before there can be either nonfeasance or misfeasance there must be a duty. Had there been a contract between the company and the owner whereby the company undertook to furnish water to the owner with a pressure sufficient for fire purposes, followed by a breach, liability would have been according to the terms of the contract. * * * There was no contract, therefore no duty imposed by contract. There is no applicable statute and therefore no statutory duty. Plaintiff argues for a common law duty, but the Court of Errors and Appeals held in *Baum vs. Somerville Water Company*, 84 N.J.L. 611 (1913), upon facts that bear a striking resemblance to the facts of the present case, that the common law does not impose a duty upon a company serving a municipality with water to provide a sufficient supply of water at sufficient pressure at fire hydrants to extinguish a fire which is destroying an individual's property. Very plainly it holds that in the absence of contract no liability exists. Appellant seeks to assail the force of that decision by arguing that in the instant case distinguishing circumstances were present, as that some hours before the fire the company had reduced quantity and pressure, and that the defendant 'interfered' with the volunteer fire department in that it prevented the firemen from rendering their ordinary assistance in putting out the fire. We have stated the reason for lowering water supply and pressure. No wantonness or malicious intent is charged. The act was in usual course. 'Interference', if that word is properly descriptive, was, specifically present in the *Baum* case. The argument is unconvincing.

"Another pertinent decision, tried at the circuit and not brought up, but never questioned, in *Atlas Finishing Co. vs. Hackensack Water Co.*, 10 Misc. 1197 (Sup. Ct. Circuit 1932), which held that while a water company may expressly contract to furnish water to a consumer in sufficient quantity and at sufficient pressure to extinguish fires, nevertheless, such an obligation is not implied from the relationship of water supply company and customer and can exist only where, in addition to the ordinary duty of supplying water for general use, the company by express contract assumes the additional obligation of furnishing it in sufficient quantity to protect specific property from fire; further, that the primary business of a water company is to furnish water as a commodity and not to extinguish fires, and that no common law duty arose even though the company had connected its water system with pipe lines, including fire hydrants, on the private property of the owner who thereafter met with a fire loss because of insufficient supply and low pressure. Even where a water company makes a contract with a municipality to deliver a supply of water to the city for fire hydrants at a specified pressure the company is not liable to an inhabitant of the city on that contract for a loss which he sustains through the company's failure to perform. *Hall vs. Passaic Water Co.*, 83 N.J.L. 771 (E. & A. 1912).

"* * * Water companies sell a commodity and their rates have been established and approved by the Board of Public Utility Commissioners upon that basis, not upon the assumption that, without an undertaking to that end, they are responsible for fire losses. A way of business has grown up on that understanding. There are many companies whose function is to insure against fire, and the property owner may protect himself fully against fire loss by contract with those companies. In the making of such a contract the premium varies with the risk and with the character of the property insured, and the insurer may limit its liability. Water rates are uniform; they do not rise or fall with the inherent danger. If the principle for which appellant contends were the law there would be no predetermined limit of liability. There are large water companies and small water companies; companies with ample supply of water and companies with limited and inadequate supply and perhaps with inability to increase the water resources; companies of such size that a considerable verdict against them for a fire loss would bankrupt them or leave them insufficiently financed to meet the general needs of their communities. Important as is a sufficient flow of water, under adequate pressure, for fire purposes, that is not the only use, nor, indeed, the most imperative use, for which a municipality needs water.

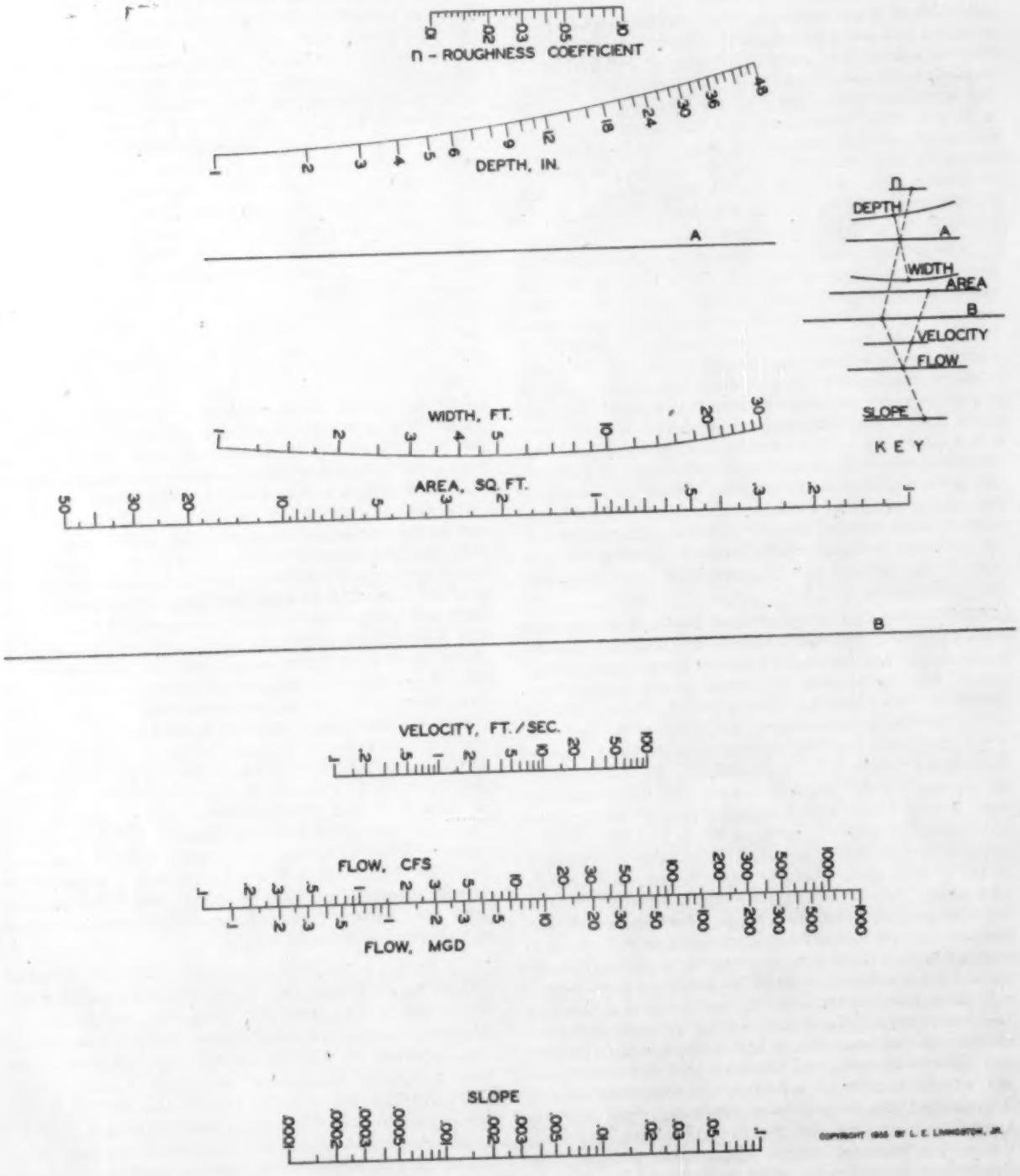
"If such a broad liability as that sought by the plaintiff were established, the ensuing litigation would doubtless be great. Fire insurance companies, entitled to subrogation to their insureds' claims could if they would, sue, whether successfully or not, upon settling a fire loss with their insureds in accordance with their contract liability. No one can foretell the degree of confusion which would follow so revolutionary a decision; a decision which would work backward as well as forward; it would unsettle the past as well as be effective in the future. * * * *."

Flow in Rectangular Channels

by L. E. LIVINGSTON, Jr.
Dallas, Texas

THIS CHART provides a convenient solution to Manning's formula for open channel flow as applied to rectangular channels. A complete solution is accomplished in four steps, as shown in the key. To find the flow in a given channel, a line is drawn through Depth (of flow) and Width to pivot line A, a second line through A and Roughness to pivot line B, and a third line through B and Slope to Flow. If desired, Area is calculated separately, and a line drawn through Area and Flow to determine Velocity.

To find the required channel dimensions for a given flow, proceed in the reverse order. If velocity is a controlling factor, a line through Velocity and Flow determines the Area necessary. Then draw a line through Flow + Slope (assumed) to pivot line B, and a line through B and Roughness locates a point on A. By rotating a straightedge about this point, a suitable combination of Depth and Width is found. It may be necessary to select a different slope and repeat the calculation if the required area cannot be obtained.



Ed. Note—The February issue of Water & Sewage Works (P. 79) carried this same nomograph but the cut was incorrectly made and should not be used.

Factors Influencing Per Capita Water Consumption

by RALPH PORGES

Mr. Porges is Sanitary Engineer, Water Supply and Water Pollution Program, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. He presents and discusses factors in water consumption that are of special interest.

MUNICIPAL water consumption will vary as influenced by a multiplicity of factors. Most will agree that the following, among others, have their effects:

1. Climate, encompassing rainfall, temperature, atmospheric conditions.
2. Size of community.
3. Type of community.
4. Cost of water and related effects of metering.
5. Water quality.
6. Availability of water.

Where industrial consumption is large in relation to the over-all water use, it may well overshadow the other variations; the use curve may reflect the business cycles. Breaking down the water uses to the domestic portion only would remove the major business influence, but statistics regarding the household fraction are scarce and probably none too reliable.

This report attempts to isolate some of the variables and to illustrate their effects on water consumption.

Method

In evaluating statistics of this type it is essential that a large number of entries be utilized to reduce to a minimum the effects of individual variations upon the general trend. In this fashion, reasonable base statistics may be evolved and the major influencing factors detected.

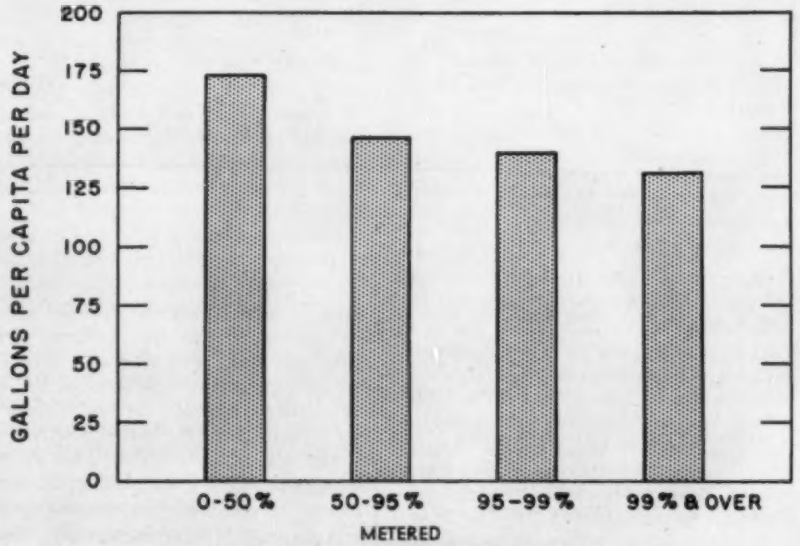
The source data for this evaluation were two municipal water supply inventories [1] [2] issued by the U. S. Public Health Service. These inventories contained data current as of 1954 and included all communities of 10,000 population and over, a 40 per cent sample of communities having populations 5,000 to 10,000, and water districts or companies serving a like population range. Some 1,532 entries were recorded.

The entries selected for the present evaluation included those that provided complete data on population served, average daily output, number of services, and number of meters. In a very few instances, small communities reporting high per capita usage (for example, over 1,000 gpd), apparently resulting from industrial demand, were omitted. The entries that fell within the specified reporting group totaled 1,474.

The statistics were developed to depict water consumption by states, by state groupings, and for the over-all reported data. These have been correlated with various factors to detect relationships influencing the variation in water consumption. To illustrate the effect of community size, the entries were tabulated by population groups as follows: 5,000 to 9,999, 10,000 to 24,999, 25,000 to 49,999, 50,000 to 100,000, and over 100,000.

The entries within these groupings were further separated by per cent metered, as follows: 0 to 50 per cent, 50 to 95 per cent, 95 to 99 per cent, 99 per cent and over. To demonstrate regional differences, the states were grouped by geographical areas as established by the U. S. Census:

Area:	States
New England	Me., N.H., Vt., Mass., Conn., R.I.
Middle Atlantic	N.Y., N.J., Pa.
South Atlantic	Del., Md., D.C., Va., W. Va., N.C., S.C., Ga., Fla.



PER CAPITA WATER CONSUMPTION AS INFLUENCED BY METERING

FIGURE 1

TABLE 1

Per Capita Water Consumption, by States

State	Number of Communities	Est. Pop. Served	Water Consumption		Av. Ann. Precip.,[1] in.
			mgd	gpcd	
Ala.	24	1,395,349	141.55	101	53.00
Ariz.	6	370,030	62.70	169	13.45
Ark.	19	571,325	52.95	90	48.06
Calif.	106	8,987,691	1,400.85	156	23.99
Col.	13	930,812	194.70	209	16.49
Conn.	31	1,740,725	226.03	130	42.36[2]
Del.					42.44
D. C.	1	1,103,000	167.50	152	42.44
Fla.	30	1,782,324	238.33	134	52.76
Ga.	23	1,615,500	199.55	124	50.16
Id.	9	163,773	27.58	168	17.91
Ill.	76	6,690,695	1,282.81	192	36.61
Ind.	55	2,138,814	294.12	138	39.45
Iowa	29	989,265	107.00	108	30.89
Kans.	28	976,520	130.57	133	26.56
Ky.	19	1,075,116	127.58	119	45.45
La.	22	1,465,900	179.52	122	55.22
Me.	16	405,892	53.19	131	42.36[2]
Md.	10	1,900,425	265.19	140	42.44
Mass.	79	3,800,450	431.65	114	42.36[2]
Mich.	57	4,799,571	729.32	152	30.37
Minn.	31	1,359,046	150.08	110	24.99
Miss.	19	575,401	67.75	118	52.86
Mo.	28	2,675,095	371.91	139	40.15
Mont.	8	218,380	46.50	213	14.88
Nebr.	19	610,119	108.69	178	22.30
Nev.	3	111,000	39.10	352	8.81
N. H.	12	280,361	30.50	107	42.36[2]
N. J.	54	3,116,294	437.38	140	45.86
N. Mex.	8	307,500	52.54	171	14.41
N. Y.	98	12,247,551	1,641.87	134	39.45
N. C.	37	1,305,209	143.77	110	49.76
N. Dak.	10	148,900	14.73	97	15.89
Ohio	79	5,622,871	846.30	151	37.73
Okla.	31	1,022,828	131.61	129	31.94
Ore.	21	879,451	127.34	145	26.92
Pa.	108	7,707,185	1,084.79	141	42.33
R. I.	9	740,374	74.27	100	42.36[2]
S. C.	14	667,500	75.92	114	47.69
S. Dak.	9	148,100	22.67	153	18.97
Tenn.	22	1,476,363	181.21	123	49.92
Tex.	87	4,873,578	695.90	143	30.54
Utah	7	349,550	93.75	268	12.63
Vt.	6	93,300	13.00	139	42.36[2]
Va.	21	1,495,997	153.58	103	42.63
Wash.	27	1,404,622	288.16	205	35.18
W. Va.	14	610,317	70.83	116	43.36
Wis.	34	1,787,131	269.36	151	30.57
Wyo.	5	104,700	21.70	207	13.93
Total	1,474	94,844,900	13,567.52	143[3]	

[1]From "Climate and Man—Year Book of Agriculture, 1941."

[2]New England rainfall quoted for each New England state.

[3]Average daily per capita consumption.

East North Central	Ohio, Ind., Ill., Mich., Wisc.
East South Central	Ky., Tenn., Ala., Miss.
West North Central	Minn., N.D., S.D., Iowa, Nebr., Kan., Mo.
West South Central	Ark., La., Okla., Tex.
Mountain	Mont., Wyo., Idaho, Colo., Utah, Nev., N.M., Ariz.
Pacific	Wash., Oreg., Calif.

Results

Table 1 shows state totals, with the number of entries reporting, estimated population served, average million gallons daily use, gallons per capita per day, and average annual state precipitation[1]. A total of 1,474 entries were recorded serving an estimated population of 94,844,900, with an average of 143 gpcd. The state averages ranged from 352 gpcd for Nevada (3 communities) to 90 gpcd for Arkansas (19 communities). The average state precipitation ranged from 8.81 inches per year in Nevada to 55.22 inches in Louisiana.

To depict the influence of population and the effect of metering, Table 2 was developed. Here, all entries are segregated into population groups No. 1 to No. 5 and into the indicated per cent metered categories.

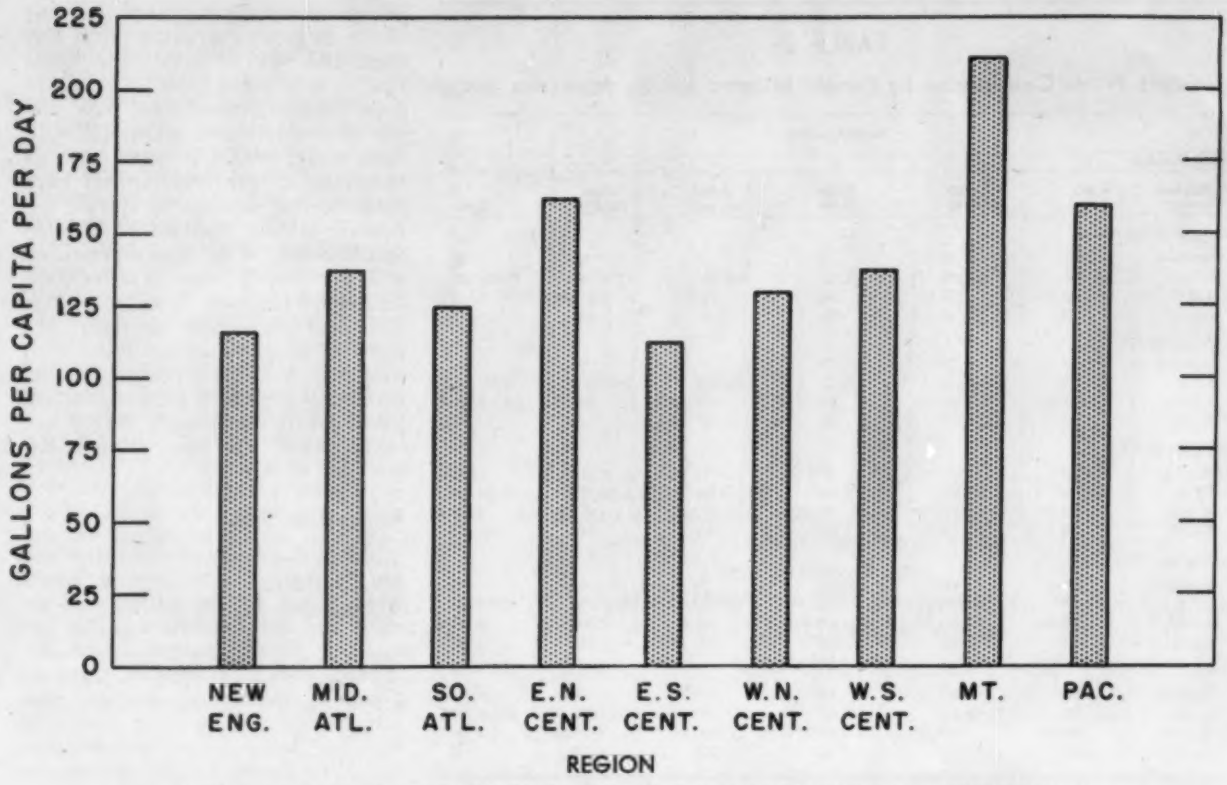
In the 0 to 50 per cent metered category, the population groups showed no firm trend, the average within the category being 174 gpcd. The 50 to 95 per cent metered category showed a marked reduction in consumption in all population groups, with the larger cities (group No. 5) having the highest per capita consumption within the category. The trend towards lower consumption continued in the 95 to 99 per cent metered category, dropping to an average of 140 gpcd. The usage variation in population groups was slight for all groups except No. 5, where the 149 gpcd was 26 gallons higher than the runner up. The over 99 per cent metered category showed an over-all reduction in unit water consumption, although the trend was not uniform in all groupings.

Water consumption by population groups as noted in the composite data was 129 gpcd for group No. 1, 134 for No. 2, 133 for No. 3, 129 for No. 4, 150 for No. 5. The marked increase of population group No. 5, with exception of the 0 to 50 per cent metered category, appears to be consistent and significant.

The composite categorical results show 0 to 50 per cent metered, 174 gpcd; 50 to 95 per cent metered, 146 gallons; 95 to 99 per cent metered, 140 gallons; and over 99 per cent metered, 131 gallons. (See Fig. 1)

Regional summations are depicted in Table 3 and Fig. 2. The lowest average per capita daily consumption of 115 gallons was reported by the East South Central region, followed closely by the New England region with 117 gallons. The highest per capita demand at 211 gpd was recorded by the Mountain region.

In an effort to delimit water usage in accordance with precipitation statistics, Table 4 was developed. The States were grouped in broad precipitation ranges as indicated and the median State value for consumption presented. This showed a downward trend in water use as precipitation increases as is illustrated in Fig. 3. To further limit the data, similar statistics for the domestic consumption were likewise tabulated. An initial trend was detected but it was not consistent.



AVERAGE PER CAPITA WATER USE BY GEOGRAPHICAL REGIONS

FIGURE 2

Discussion

Evaluation of Base Data

One of the principal considerations in the utilization of data is reliability of the initial compilation. The data used in preparing the inventories on which this report is based were assembled originally from previous tabulations developed by the Public Health Service in cooperation with the State Health Departments, the most complete being the 1949 unpublished inventory, and from other available sources. These data were then forwarded to the regional offices of the Public Health Service, from where they were sent to the State Health Departments.

In virtually all instances, the states referred the data to the local facility for check, review, correction, and completion by local officials. The data received reviews at all levels and questionable items were returned to the states and local facility for ultimate clarification. It is recognized that some errors do persist, but it is believed these are minor and do not influence the conclusions. On the other hand, the data represent probably the most reliable information to date.

Another factor of consideration is the equipollence of comparative statistics. In all instances are statistics of equal value being utilized. It is necessary to consider, when comparing gross per capita consumption values, the number of communities reporting and the population grouping, and to recognize inherent differences that may occur.

It has been estimated[5] that about 17,000 communities in the United States in 1954 had public water systems serving approximately 115,000,000 people. The 1,474 communities of this study represent nearly 9 percent of the municipalities and 83 percent of the total estimated population served. The per capita consumption of the sampled group was 143 gpd. This compares with 149 gpcd reported for 570 communities of 25,000 population and greater, and an estimated 140 gpcd for all 17,000 public water supplies[5]. Again it is cautioned that these variations are probably due to population selection.

Comparison of 1948 and 1954 Inventories

The following depicts comparative water consumption by stated population groupings in 1948[6] and 1954:

Pop. Group	Average Demand, gpcd 1948[6]	1954
5,000 — 9,999	114	129
10,000—24,999	123	134
25,000—49,000	127	133
50,000—100,000	121	129
Over 100,000	157	150
Total	142	143

The average water consumption in 1948 was 142 gpcd, whereas the 1954 average was 143 gpcd. It is interesting to note that in 1948 the water consumption of the smaller communities (5,000 to 10,000 population) was 114 gpcd as compared to 157 gpcd in communities of over 100,000 population. The 1954 statistics indicate an increase in the water consumption of the smaller communities, but a reduction in the largest population group. This may be significant and indicate a leveling in water consumption of communities. Decentralization of industry definitely would hasten this trend. The use of municipal water by industry has been pointed out by Picton[7], who states that 20 percent of the manufacturing industry is served by public systems.

In 1948 the population group 5,000 to 100,000 reported an average consumption of 122 gpcd, whereas sim-

TABLE 2

Municiple Water Consumption by Percent Metered and by Population Group

	Municipalities					
Code Number	1	2	3	4	5	6
Population Group	5,000-9,999	10,000-24,999	25,000-49,999	50,000-100,000	Over 100,000	Total
Metered 0-50%						
Number	51	72	18	8	11	160
E.P.S.*	441,467	1,452,224	794,761	965,261	15,374,760	19,028,473
A.D.O.	80.47	273.76	165.81	187.47	2,611.45	3,318.96
Gpcd	182	189	209	194	170	174
Metered 50-95%						
Number	53	76	36	15	14	194
E.P.S.	506,780	1,485,941	1,603,109	1,314,048	8,077,747	12,987,625
A.D.O.	62.63	191.55	209.75	179.52	1,255.50	1,898.95
Gpcd	124	129	131	137	155	146
Metered 95-99%						
Number	38	55	37	17	24	171
E.P.S.	312,864	1,013,859	1,879,367	1,732,936	9,830,772	14,769,798
A.D.O.	38.03	121.73	231.26	211.42	1,464.24	2,066.68
Gpcd	122	120	123	122	149	140
Meter over 99%						
Number	211	434	159	79	66	949
E.P.S.	1,882,772	7,984,950	6,814,232	7,209,252	24,167,798	48,059,004
A.D.O.	223.85	1,017.17	870.89	865.45	3,305.57	6,282.93
Gpcd	119	127	128	120	137	131
Total						
Number	353	637	250	119	115	1,474
E.P.S.	3,143,883	11,936,974	11,091,469	11,221,497	57,451,077	94,844,900
A.D.O.	404.98	1,604.21	1,477.71	1,443.86	8,636.76	13,567.52
Gpcd	129	134	133	129	150	143

*E.P.S. = Estimated population served; A.D.O. = Average daily Output; Gpcd = Gallons per capita per day.

ilar 1954 statistics showed 132 gpcd, yet the group over 100,000 population dropped from 157 to 150 gpcd. Thus, it must be concluded that, on the average, consumption in communities less than 100,000 population had increased slightly, in communities greater than 100,000 consumption had decreased slightly, and the overall average, based upon these statistics, showed little change.

However, probably even more important is the fact that in communities over 10,000 population (all communities in this grouping included in both 1948 and 1954 inventories) the estimated population served increased 60 per cent in the short span of six years as result of increase in population and servicing of suburban areas, and the total water demand showed a corresponding increase.

The reduction of per capita water use in communities may result from temporary climatic influence, better plant and system management, and conservation measures, particularly in industrial processing. An effective leak detection program, stepped-up plumbing inspections, and metering is reported[8] to have reduced water waste in Chicago by 390 mgd. From 1930 to 1954 the average consumption per person was reduced from 300 gallons to 234 gallons. There would appear to be room yet for additional savings in waste water.

Others have reported trends that appear contrary to the foregoing. No doubt, local conditions play the all-important role. For example, Poole[9] reports for Indiana that water consumption is increasing at the rate of 2.1 gallons per person per year, and that in cities above 100,000 the rate of increase is 3.3 gallons per year while in cities between 25,000 and 100,000 the increase is 2.3 gallons per year.

Water Companies

It was noted that entries not communities as listed in the United States Census (such as water districts, county systems, and water companies serving a group of communities) reported relatively low consumption figures. An average of the 71 reporting was 114 gpcd as compared to the total average of 143 gpcd. Because these entries may serve areas not classified as urban, the low per capita consumption might result from the lack of industry in rural areas.

Effect of Metering

Metering seemed to have a pronounced effect. Generally, per capita water consumption was downward as per cent metering increased. For example, in group No. 1 the range was from 182 to 119 gpcd; the totals ranged downward from 174 to 131 gpcd. On the basis of these data, 100 per cent metering of unmetered supplies would result in water savings exceeding 25 per cent. Others have noted similar savings in specific instances. It was reported[10] in 1938 that Jackson, Miss., had experienced a 30 per cent decrease in water consumption statistics from numerous individual cities also indicates that metering tends to control water consumption. Yet some communities experiencing expanded industrialization have shown increasingly larger per capita water use even though 100 per cent metered.

Regional Influence

Table 3 depicts municipal water use by regions. This type of breakdown brings out the influence of climate and industrialization. The humid east (New England, South Atlantic, and East South Central groups) reported an average consumption of 125 gpcd or less. The Middle Atlantic, West North Central, and West South Central groups reported per capita daily consumption from 131 to 137 gallons. The Pacific states showed 161 gallons, East North Central 163, and the Mountain states 211.

The influence of industrialization may be assumed to have raised the water needs of the East North Central states, whereas the dry climate of the Mountain states also increased water consumption, probably as result of irrigation and air conditioning demands.

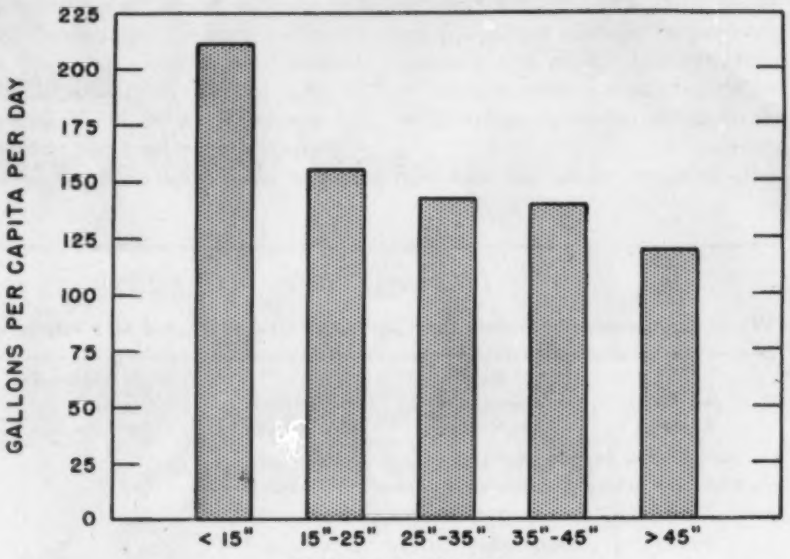
In an effort to more clearly evaluate climate, the states were considered according to increasing annual average precipitation (precipitation values shown in Table 1). Nevada, the lowest state with 8.81 inches of rain, reported the highest per capita consumption of 352 gallons per day. Utah, second with 12.63 inches, reported 268 gallons, the second highest. The trend thereafter was not consistent, although generally downward. However, the most humid states, being in the South, also are the states with the highest temperatures, which may cause greater water use resulting from air conditioning demands.

Table 4 gives a brief summary of these results. With the six states having rainfall of less than 15 inches, the median consumption was 210 gpcd. The trend shown is downward, so that with the eleven states having rainfall greater than 45 inches, the consumption was 119 gpcd.

Only 162 communities reported on the domestic portion of their water consumption. These statistics are included in Table 4. Of five states reporting less than 15-inch rainfall, the median domestic consumption was 92 gpcd. The consumption dropped sharply to 55 gallons in the 15- to 25-inch rainfall group, but no firm trend thereafter is indicated. For eight states having rainfall exceeding 45 inches, the per capita domestic consumption was 64 gpcd. As previously mentioned, high temperatures of the humid states may have caused this increase in consumption.

An additional evaluation of the reported domestic consumption statistics showed[11] that within each population class-percent metered cell, those cities in the lowest precipitation group (10 to 25 inches per year) had the highest domestic consumption. However, there were no consistent differences in domestic consumption among the other precipitation classes.

An interesting method of analyzing the effect of weather and climate on water consumption of a given community has been presented by Leadbeater[12]. He devised a formula that provides for rainfall, temperature, relative humidity and number of wet days, and claims that rainfall is the factor having the most influence; the lower the rainfall, the greater the consumption. The data herein tend to confirm this reasoning.



PER CAPITA WATER CONSUMPTION AS RELATED TO PRECIPITATION

FIGURE 3

Summary and Conclusions

Municipal water facility data as of 1954 from 1,474 community entries having 1950 United States Census populations of 5,000 and greater and were analyzed to indicate some factors that may influence average daily per capita water consumption. Other pertinent items and comparisons are noted.

The following conclusions may be drawn:

1. The average daily per capita demand for the 1,474 entries serving 94,844,900 persons was 143 gallons in 1954.

2. The population of the community affected the consumption. The 5,000 to 100,000 population group averaged 132 gpcd. The consumption of cities over 100,000 population was higher, at 150 gpcd.

3. Water districts and water companies serving groups of communities reported a low consumption of 114 gpcd.

4. The average demand of entries with populations ranging from 5,000 to 10,000 was 122 gpcd in 1948, as compared with 132 gpcd in 1954. In cities over 100,000 population, the demand was 157 gpcd in 1948 and 150 gpcd in 1954. Considering all municipalities over 5,000 population, the average consumption was 142 gpcd in 1948, as compared to 143 gpcd in 1954.

5. During the short period of 6 years (1948 to 1954) the estimated population served by municipal water systems of communities having populations greater than 10,000 increased 60 per cent, with a corresponding increase in water consumption.

6. The average per capita municipal consumption decreased as the per cent metered category increased. It appears that metering of a water supply might result in an over all reduction in unit water use of over 25 per cent.

7. Regional grouping of statistics brought out the variations in the several parts of the country. The East South Central states were lowest, with 115 gpcd; the Mountain states were highest, with 211 gpcd. The industrialized East North Central states were second highest, with 163 gallons, followed closely by the 161 gallons of the Pacific states.

8. The average per capita consumption for states ranged from 353 gpcd for Nevada to 90 gpcd for Arkansas.

TABLE 3

Per Capita Water Use by Geographical Regions*

Region	No. of Communities	Population Served	Consumption mgd	gpcd
New England	153	7,061,102	828.64	117
Middle Atlantic	260	23,071,030	3,164.04	137
South Atlantic	150	10,480,272	1,314.67	125
East North Central	301	21,039,082	3,421.91	163
East South Central	84	4,522,229	518.09	115
West North Central	154	6,910,045	905.29	131
West South Central	159	7,933,631	1,059.98	134
Mountain	59	2,555,745	538.57	211
Pacific	154	11,271,764	1,816.33	161
Total	1,474	94,844,900	13,567.52	143†

*U. S. Census regions.
†Average.

Those states with the lowest annual precipitation reported the highest per capita demand. There is a tendency for the per capita consumption to decrease as the annual precipitation increases.

9. Domestic water use was high (92 gpcd) in states having less than 15 inches annual precipitation. The domestic consumption decreased to 55 gpcd in states with annual rainfall ranging from 15 to 25 inches; with increasing rainfall the demand showed but slight variation.

TABLE 4

Water Consumption in Gallons per Capita per Day as Related to Precipitation

No. States Reporting	No. Communities Reporting	Precipitation, State Average,	Water Consumption, Median of State Average,
		(a) TOTAL MUNICIPAL WATER CONSUMPTION	
6	37	< 15	210
7	197	15 — 25	156
7	287	25 — 35	143
17	670	35 — 45	139
11	283	> 45	119
48	1,474	30*	139*
		(b) DOMESTIC MUNICIPAL WATER CONSUMPTION	
5	6	< 15	92
7	25	15 — 25	55
7	38	25 — 35	57
12	63	35 — 45	42
8	30	> 45	64
39	162		

* Average.

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Asphalts As Protective Coatings

Clarification of an earlier statement.

A discussion of the problem of sulfides in sewers was published in *Water and Sewage Works* in March, 1956 (pp. 133-136). A statement was there made by the author, Richard Pomeroy of Pasadena, Calif., about the amounts of water which may be absorbed by asphalt under some conditions, with inferences drawn therefrom as to the ability of asphalt to protect metal or concrete against corrosion.

The following is a statement of clarification that Dr. Pomeroy has submitted.

"It is true that the kind of asphalt coatings that have been applied to pipe in many cases have afforded sparce to poor protection. There are no cases of long-time successful experience with asphalt coatings under conditions such as might exist in a sewer containing hydrogen sulfide. However, it does appear that a statement in my article in the March 1956 issue of this magazine was too broad. It implied judgment of all asphalts on the basis of an extreme case of water absorption, considerably beyond the range of other data on water absorption by asphalts. There are large differences between different asphalts, depending upon source, processing, and compounding, and there are corresponding differences in the degree of protection against corrosion that different asphalts provide."—Richard Pomeroy, Consulting Chemical Engr., Pasadena, Calif.

Robt. Harris Heads PHS Federal Assistance Program for Sewage Works

This year's funds will be used up

Robert Harris of Bethesda, Md., has been appointed Chief of the 10-year, $500-million program of federal assistance to municipalities for the construction of sewage treatment facilities. Mr. Harris has been in the Public Health Service since 1949 and was formerly with the Kentucky State Health Dept.

According to Mr. Harris, the current year's $50 million fund will be used up by the end of the fiscal year. Requests for this year have already amounted to $80 million for some 831 projects having an estimated total cost of $430 million.

Initial grants to more than 210 applicants in 38 states amount to $17.5 million and grant approvals are now being made at about $3 million a week.

U. S. Companies Help Train Israel Engineers

Mr. Moshe Nave, Israeli waterworks engineer (left) is being trained at De Laval Steam Turbine Co. plant in Trenton, New Jersey, U. S. A. in the latest techniques of installation, repair, and maintenance of waterworks pumps.

Israel, largely dependent on water from deep wells for agricultural, domestic, and industrial uses, has over 500 deep-well pumps in operation. Mr. Nave directs 12 field crews of the Mekoroth Water Company in Israel. On his return to Israel, Mr. Nave will instruct personnel there on techniques he learned in the U. S.

How to Increase Revenue Without Raising Water Rates

by RAYMOND F. BISHOP

Mr. Bishop is Superintendent of the Board of Public Works in Bonnville, Mo. In this article he presents sound arguments for the importance of a meter maintenance program.

WATER METERS constitute a type of mechanism common to all water departments, whether they have large or small plants, surface water or ground water sources, or just pump the water to a tower or storage basin.

These meters, because of their very function, may be considered as "employees" of the department. Just as insurance companies depend on their local agents to make monthly collections, the grocer depends on his cash register to record every sale, and the service station owner depends on his gasoline meters to register the smallest delivery accurately, water departments depend on their meters to record accurately and completely, the smallest—and the largest— delivery of their product to the customer. In fact, in most cases it is the meters that record the revenue that pays for wages, repairs, replacement of worn out equipment, construction of new mains, and the many other things involved in operation of a water system.

Mechanical Employees

These mechanical "employees," however, are usually looked at only once a month, and then only to read the accummulated revenue, not to check their efficient functioning. In many instances poor functioning of a meter is never detected until it ceases to function at all, despite the fact that long before many meters turn over for the last time they fail to register that small flow of one gallon per minute or less. In other words, it has become an ill employee who is only working part-time.

Proper meter maintenance is an obvious remedy. A properly maintained water meter is an accurate device and as such is fair to both the customer and city alike. In any event the chances of the customer being overcharged are negligible, as a neglected disc-type water meter usually runs slow rather than fast.

In other words, if the meter is not registering the small flows (and that is the most common defect), a ¼-gpm leak in a toilet flush box will cost the department 360 gpd, or 10,800 gallons per 30-day month, or 130,000 gallons per year.

Many meters that have been in service for five years will not register this flow. Nevertheless, from 11 to 15 per cent of all water used in private homes flows at a rate of ¼ gpm or less, and 25 per cent at 1 gpm or less. Without this low-flow registration a dripping faucet may cost the department 5,000 gallons per month.

One city provided a startling example of the foregoing point. This city removed forty ⅝-inch meters that had been in service five years and made a flow test on them. Of these, 36 would not move at all on

SMALL BUT EFFICIENT meter repair shop makes for efficient use of pumped water and provides for full revenue collection.

Ed. Note: This paper was presented by the author at all the district meetings of the Missouri Water & Sewage Conference and at the annual joint meeting of the Missouri Sect. AWWA and the Conference. It was released for publication in *Water & Sewage Works*

TABLE 1

Free Water Furnished Customer When Meter Registers Inaccurately

Meter Registration, %	Water Furnished Free	
	Days per Year	Gallons per 1,000 Gallons Used
95	19	50
90	38	100
85	57	150
80	77	200
75	97	250
70	105	300
65	129	350
60	146	400
55	164	450
50	182	500

the ¼-gpm flow and the remaining four were completely dead on both the ¼-gpm and the 1-gpm flows. Why should a homeowner call a plumber for that dripping faucet or leaking toilet flush box when his meter will not register the flow caused by the leak?

Another city found a 57 per cent loss of water. A leak survey was made and other steps were taken to find this unaccounted-for water. Finally, all meters were brought in for test. Many were completely dead; 15 to 20 per cent were found to be slow. After testing, cleaning, and repairing, the meters were replaced in the system; all but 18 per cent of the filtered water was accounted for, with a net gain of $4,000 in the first five months.

Other Costs Involved

Although pumping cost increases are an important factor necessitating reduction of water system losses, there is another important element—the savings in chemicals, machinery wear, etc., not only in the water plant, but also in the local sewage plant—when these waste losses are cut to a minimum.

All meters should test at least 90 per cent on the ¼-gpm flow. Surveys show that more than 2,000 mil gal daily of water are wasted or otherwise unaccounted for in this country each day. Most of this could be controlled by proper metering and adequate maintenance. Any local water shortage or sizeable waste flow calls for a complete meter testing program to determine where the excessive flows are and to insure proper payment for the water used.

No meter should be in service more than ten years: the average should be five years, depending on the type of water in the system. Metering alone is not enough: Installation of a meter does not mean the end of all troubles; as metering efficiency decreases, revenue and net earnings go down. It is at this point that most people begin to think about increasing water rates, whereas many times it would only be necessary to inaugurate and maintain a proper testing and meter repair program, which should be an integral part of any water system.

Water meters are mechanical and, therefore, need attention. It is not easy, usually, to get the city officials to raise water rates, but they will buy test equipment and meter repair parts.

Results of Meter Maintenance

A meter testing program was set up at Boonville, Mo., several years ago with the goal of removing, testing, cleaning and repairing all meters. At the time this article was written 1,100 of the 2,000 meters had been tested and repaired. The maximum service time was 32 years, the minimum five years, and the average ten years. The average results for these 1100 meters were as follows:

Flow Rate	Accuracy
12 gpm	82%
1 gpm	71%
¼ gpm	52%
Average	68%

This meant a loss in water and revenue of 32 per cent.

At an average cost of $6.25 per meter for parts and labor, meters were removed, cleaned, repaired, tested and replaced. Tests after repair indicated the meters to register as follows:

Flow Rate	Accuracy
12 gpm	100%
1 gpm	101%
¼ gpm	99%
Average	100%

At present rates in Booneville this meant a saving in water of 32 gallons for each 100 gallons used, or an actual gain in revenue of 1.6 per cent for each 100 gallons delivered. The minimum charge is $1.13 for 2,250 gallons, and with the unrepaired meters this meant that although 2,970 gallons were being delivered only 2,250 gallons were being paid for. In other words, customers were being given free, 720 gallons per month. The revenue thus lost amounted to $0.36 per month on each minimum customer. Projecting this over the 1,100 meters repaired, based on the minimum bill, the savings in water was 825,000 gallons per month, or a net monthly gain in revenue of $412.50.

This leaves no doubt as to the importance of a meter maintenance program, even in a small system.

How much water is a water utility giving away each month? Table 1 gives the amounts of water given away without revenue for each meter under various conditions of meter inaccuracy. Obviously, this may be a large proportion of a system's water shortage. As mentioned previously, more than 2,000 mgd of water are being wasted across the nation.

Summary

It is recommended that any water superintendent know his water meters, and keep a record of each including the date installed, size, flow, serial number and location. Also, when the meter is removed for test that a record be made of its flow before cleaning and after cleaning and repair, its time in service, the amount registered between tests, the parts used, the reason for test, and the total cost of repairing and replacing.

Water is cheap—too cheap—but not so cheap that it should be thrown away.

List of USPHS Research Grants

A list (No. 4) of PHS research grants awarded in water supply and water pollution control studies from July 1 to Dec. 31, 1956, is now available. The list includes the names of the various colleges and universities in each state which have received grants. Also included in the listing is the name of the director of the research project, the title of the research project, and the amount of the grant. Seventy-two grants are included in the list. A copy of the list may be obtained from Harry A. Faber, Research Coordinator, Offices of Engineering Resources, Div. of San. Engr. Services, U. S. Public Health Service, Washington 25, D.C.

LA MARIPOSA water treatment plant for Rio Tuy, which runs behind mountains in background.

Caracas, Venezuela

New Water Supply from Rio Tuy

by ING. ANDRES MARCANO-COELLO

Mr. Marcano-Coello is Chief of the Treatment Plant Division of the National Institute of Sanitary Works, Caracas, Venezuela.

CARACAS undoubtedly is one of the fastest growing cities in the world. To illustrate the point: In 1952 its rate of increase of population was estimated to be approximately 7.64 per cent per year. As it happens, the total population of the Metropolitan Area, being about 400,000 in 1941, has since reached over one million people in the year 1956. It can easily be imagined that the water works constructed in the late 40's, designed for a population of 739,000 people by the year of 1980, have fallen far too short in their aim and are unable to meet even the present demand.

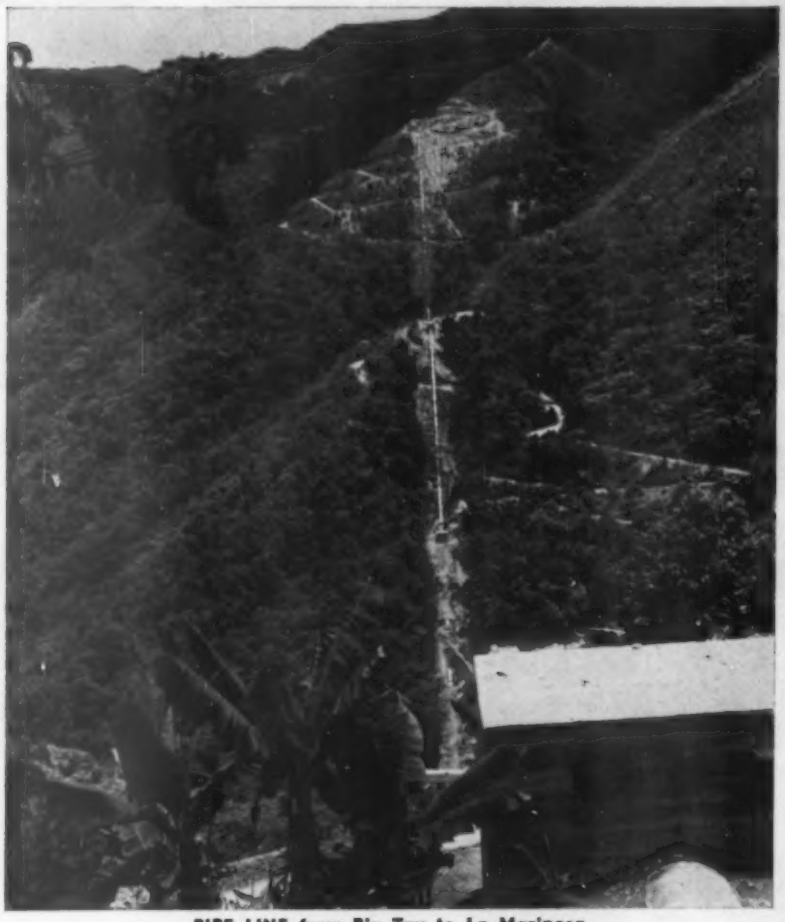
New Supply Needed

The city of Caracas is located in the Guaire River Valley, at an average elevation of 3,000 feet and more above sea level, surounded on all sides by steep mountains. The existing water works have been using up practically all the available sources within the river watershed, as well as the upper region of the Rio Tuy, tapped and diverted at an elevation of 5,600 feet at a distance of some 37 miles from the outskirts of the city.

To meet the problem at hand, Engineers of the National Institute of Sanitary Works studied different possible sources for a new water supply outside the Guaire River watershed, finally reaching the conclusion, that pumping from the middle section of the Tuy River, would be the most favorable solution.

The system, now already in operation, is pumping water at the rate of 47,600 gpm. against a total static head of 3,120 feet (total dynamic head of 3,490 feet).

The water is taken from a river intake constructed at an elevation of 433 feet, pumped through a 49-in. diameter steel pipe by means of one low-lift and four high-lift pumping stations, to the high point of the system at "Cortada del Guayabo" (Elevation 3,553 feet), from there passes through a one mile long tunnel of 78-in. diameter to connect with the El Valle river, follows the open river bed for about 4.5 miles to reach the Mariposa reservoir, from where it is sent to the Mariposa Water Treatment Plant, located at a distance of about 3/4 of a mile from the reservoir, and then passed on to the consumers.



PIPE LINE from Rio Tuy to La Mariposa.
17 miles long, it starts at Elev. 433 ft and rises to 3470 ft.

TRANSMISSION line (48-in) is set by winch operated cable carriers.

About The Author

Ing. (Engineer) *Andrès Marcano-Coello* was born in the town of Carupano in Venezuela in 1921. He received his primary and secondary education at the Liceo Andrès bello in Caracas and then studied engineering at the Central University, also in Caracas, graduating in 1947. He received his M. S. at M.I.T., in Cambridge, Mass., where he studied from 1948 through 1951. On his return to Venezuela, he joined I.N.O.S. (National Institute of Sanitary Works) as an engineer, where he now holds the post of Chief of the Treatment Plants Division.

Details of the Project

The river intake is located at a distance of some 25 miles from the city outskirts; consists of a 7 feet high weir across the river and a lateral intake protected by steel bars. A circular gate equipped with an electric motor is provided on the side nearest to the weir, to permit the flushing-out of sediments. The gate is designed to open automatically in case of high waters, so as to avoid flooding of the properties surrounding the intake.

Two 48-in. diameter concrete pipes convey the water by gravity to a low-lift pumping station, located about 800 feet from the river side. This station lifts the water about 20 feet to the pretreatment installation.

During the rainy season the Tuy River water is very muddy and carries great quantities of fine sand. During the dry season the hardness of the water increases to nearly 300 ppm, resulting in an increased tendency towards calcium carbonate deposits in the interior of pipes. To avoid wear and tear in the pumping units and to avoid rapid silting-up of La Mariposa reservoir, these settling basins with a total capacity of 1,428,000 gal. and a retention period of 30 minutes were designed and constructed near the river intake. Here also, recarbonation units have been installed to apply CO_2 whenever deemed necessary, to reduce calcium carbonate deposit in the pipeline; as well as facilities to apply chlorine solution to eliminate the growing of slime in the conduits. The water so treated passes on to the suction-well of No. 1 high-lift pumping station and the start of the 49-in. diameter steel line.

Transmission Line and Pumping Stations

The steel pipe, with a total length of about 17 miles, is protected on the outside with a 1/8-in. thick coat of bitumastic and glass wool and on the inside with a 1/8-in. thick coat of bitumastic only, both applied by the hot process.

Pumping stations No. 2, 3 and 4 are spaced along the line in such a way that the difference in the dynamic level between each station is the same, thus all pumps have the same design load. There are four pumps in each station or a total of 16 pumps in all, each equipped with a motor of 3800 hp. The control of the pumping operation is handled automatically from No. 1 pumping station.

Surge-towers are installed in the transmission line between the different pumping stations. The flow between these and the next station is by gravity. Before the inlet to each station a small reservoir has been constructed, used for the installation of the control switches for automatic operation of the pumps.

Between pumping stations No. 3 and 4, a short tunnel, 575 feet long and 78-in. in diameter, was drilled through an intervening mountain and lined with plain concrete one foot thick.

The pipeline ends at the south side of the mountain dividing the Tuy River and the Valle riversheds. Here a concrete lined tunnel, 78-in. in diameter and one mile long, conveys the water through a mountain and connects with El Valle river. From there on the open river bed is used for a stretch of about 4.5 miles to bring the water in to La Mariposa reservoir.

Reservoir and Treatment Plant

The Mariposa reservoir is an earth dam, constructed during the late 40's, to store the water of El Valle and Turmerito rivers. It has a capacity of 340 million cubic feet. In the past the dam has been regulating 7,900 gpm, now with the water pumped from the Tuy river it will have an output of 55,500 gpm. The original service pipe from the reservoir to La Mariposa Water Treatment Plant has been changed from a 30-in. concrete pipe to a 72-in. steel pipeline, about 4000 feet long.

La Mariposa Water Treatment Plant was built in 1951 for treating the water from La Mariposa Dam. The plant employs coagulation, flocculation, filtration and disinfection by means of chlorine. In view of the increasing demand, the plant output was rapidly increased up to a maximum of 12,700 gpm.

PRESIDENT of Venezuela, Marcos Jiminez (3rd from left) and staff members at plant dedication Aug. 15, 1956.

The original plant consisted of two rapid mixing units, two flocculation and two sedimentation basins, a recarbonation unit and six rapid sand and gravel filters. Facilities were provided for treating the water with aluminum sulphate, lime, activated carbon, activated silica, chlorine and carbon dioxide. The main buildings consist of an Administration Building, housing apart from the main control centers of the plant, a fully equipped modern laboratory and a special building for the chemical feed apparatus, etc.

During the operation for a period of five years it was found that the plant as built and utilizing only one of each of the pre-treatment units, was able to produce water of an excellent quality with the existing six filters at the rate of 11,000 gpm.

To increase the capacity of the plant to 55,000 gpm, three new flocculation and three sedimentation basins were added, as well as an additional tank for recarbonation and 12 new rapid sand and gravel filters. As far as the chemical feeding equipment was concerned, it was only necessary to change the chlorinators and add a feeder for the application of polphosphates.

The contract of the completed new water works calls for an expenditure of 45 million dollars. In this price is included the cost of laying a new transmission line with a diameter of 72-in., from the plant to the city, for a stretch of about 2.5 miles, and the installation of new water mains in the city proper, ranging in diameter from 10 to 60 in. and a total length of about 44 miles.

With the completion of the new water works, the city of Caracas will have a total water supply to meet the demand of 1,500,000 inhabitants.

AIR VIEW of Venezuela's booming capital city, Caracas.

WATER WORKS PRACTICES

Corrosion—I

What it is; what it does

The thirty-ninth of a series

by GEORGE E. SYMONS, Ph.D

In this series, Dr. Symons discusses water works practices in the form of short school lectures, designed to assist operators, students and others who wish to review fundamentals in this field.

A . . . Basic Generalizations

1 . . . DEFINITIONS

a. Corrosion is defined simply as the act or process whereby a substance is gradually eaten away.

b. In stricter terminology, corrosion is the act or process whereby a solid substance is "eaten away" in the presence of water, liquid or vapor.

c. Actually, the basic reaction in the process of corrosion is one of solution followed by other physical manifestations.

d. Erosion is also a process whereby a solid substance is gradually "eaten away", but the mechanism is different and the process should not be confused with corrosion.

(1) In the case of erosion, one solid substance is worn away by the impingement or rubbing of other solid substances thereon. Water may or may not be involved as the carrier of the impinging solids.

(2) Typical of the erosion process is sand blasting, the wearing away of steps and the scouring action of sand on metals, concrete, etc.

e. Corrosion is generally thought of in connection with metals, but concrete will also corrode in the sense that its cementing substances will dissolve in water or acids.

2 . . . UNDESIRABLE EFFECTS OF CORROSION.

a. Destruction or deterioration of distribution system components.

(1) Incrustation of metal pipe lines, causing loss of carrying capacity and loss of head.

(2) Weakening of pipe structures with resulting ultimate failure and leaks in main lines, in service lines, and in household piping and water heaters.

(3) Weakening and failure of storage tanks resulting in leaks and possible complete collapse.

(4) Interference with the proper operation of water meters, both main line and household meters.

(5) Interference with the proper operation of valves and hydrants.

b. Deterioration of water quality.

(1) The effects of corrosion may be evidences in water supply quality in several ways.

. . . Turbidity may appear, especially if corrosion products (incrustation) is flushed from the walls of the pipe.

. . . A color may be imparted to the water; iron picked up by corrosive action may cause a reddish color if the iron is in colloidal form.—Copper dissolved from service or household lines will impart a bluish cast to water.

. . . Tastes of an unpleasant metallic variety will be imparted to the water if the concentration of the metallic ion exceed certain minimal values. Water containing 0.5 to 2.0 mg per liter of iron has a sharp metallic taste; copper has a perceptible taste at 5 to 10 mg/L, while zinc can be tasted at about 20 mg/L.

(2) Undesirable effects on household appliances and equipment result from the presence of dissolved metal ions in the water.

. . . If iron is present in concentrations greater than 0.3 mg/L, brown stains will appear on the bathroom and kitchen fixtures.

. . . Copper in water will cause blue stains on bathroom and kitchen fixtures.

(3) Some metal ions in solution adversely affect health and are considered toxic when present in concentrations above certain maximum limits.

. . . Lead is the most harmful and any concentration higher than 0.1 mg/L is unsafe for potable water supplies.

. . . Copper should not be present in concentrations above 3.0 mg/L.

. . . Zinc may be present in concentrations up to 15 mg/L without harmful effects.

. . . Iron in water has no toxic effects but high concentrations of iron are said to cause constipation.

B . . . Theory of Corrosion

1 . . . GENERAL

a. In the lecture on properties of water, it was pointed out that water, itself, may have chemical activity as an acid, as a base, as an oxidizing agent, and as a reducing agent. It was pointed out, also, that water has an ability to dissolve almost every substance to some degree.

b. Metals have a tendency to revert from the metallic form to the more stable forms of oxides, hydroxides, or salts, particularly in the presence of moisture.

c. It is these chemical characteristics of water and metals which are the basic factors in corrosion.

d. In the case of cements, stone,

Ed Note: Dr. Symons is Executive Vice President and Editorial Director of the Scranton Publishing Co.

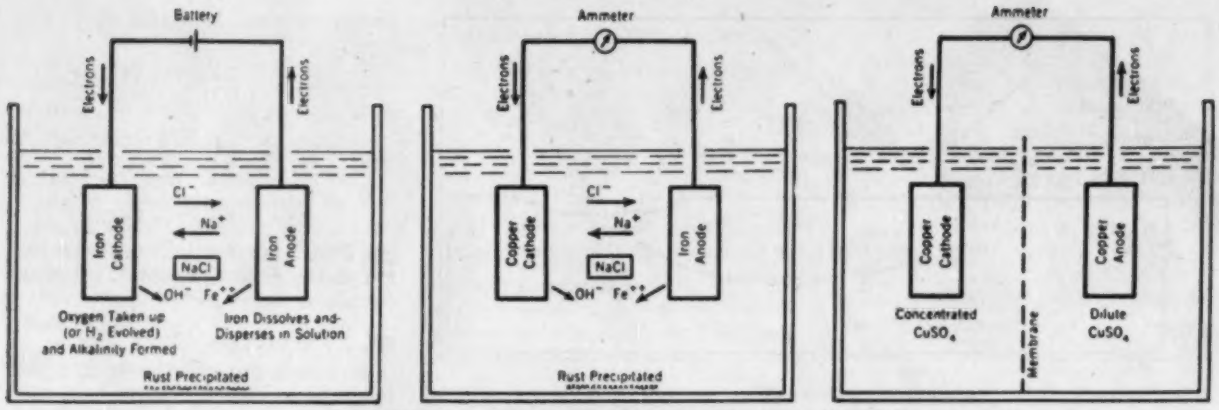


Fig. 1—TYPES of corrosion cells (After Eliassen and Lamb)

Left—Impressed current cell; the current flow between the electrodes results in a loss of metal in the anode

Center—Galvanic Cell; the reactions at the electrodes are identical with those in the impressed current cell, but the current flow is due to the difference in electrode potential rather than to an external source.

Right—Concentration cell; in this type of cell, the difference in electrode potentials results from the difference in metal ion concentration in the solutions.

etc., the tendency to corrode is simply a manifestation of the solubility of that substance in water and that solubility may be affected by the presence of hydrogen or other ions.

2 . . . Fundamental Theory of Metal Corrosion

a. The generally accepted theory of metal corrosion is that it is an electro-chemical process in which four steps are involved.

(1) Anodic reaction.

(2) Cathodic reaction.

(3) Depolarization.

(4) Reaction of metal ions.

b. Metals have a tendency to corrode or to go into solution according to the electrode potential of the metal in that solution.

(1) When metals are listed in the order of that potential, the listing is termed the electro-motive force (emf) series, in which hydrogen is taken as zero.

(2) The emf series for metals used in water works practice is shown in Table 1.

TABLE 1

Electromotive Force Series

Metal	Electrode Reaction	Standard Electrode Potential — volts * E_o at 25°C.	
Magnesium	Mg—Mg^{++}	$+2e^-$	−2.34
Aluminum	Al—Al^{++}	$+3e^-$	−1.67
Zinc	Zn—Zn^{++}	$+2e^-$	−0.762
Iron	Fe—Fe^{++}	$+2e^-$	−0.440
Tin	Sn—Sn^{++}	$+2e^-$	−0.136
Lead	Pb—Pb^{++}	$+2e^-$	−0.126
Hydrogen	H_2—$2H^+$	$+2e^-$	0.000
Copper	Cu—Cu^{++}	$+2e^-$	+0.345

*Signs of potential employed by Amer. Chem. Soc. are opposite to those in this table.

(3) The metals listed in Table 1 are listed in the order of decreasing tendency to go into solution.

(4) Generally speaking, the emf series indicates that each metal will displace from solution any metal below it in the series.

. . . This is true for metals widely separated in the series, but not necessarily true under some conditions for metals close to each other.

. . . In the case of iron and zinc, for instance, zinc may be used as the sacrificial metal coating to protect the iron, but in fresh water at temperatures above 65°C, the situation reverses and the zinc is no longer sacrificially protective.

(5) Since the emf series does not hold true for various conditions met in water works practice, both Uhlig and Speller have proposed that metals should be arranged in a galvanic series, which lists the metals in electropotential sequence in a given environment.

. . . Eliassen and Lamb in the JAWWA in 1954 gave the example of a galvanic series shown in Table 2.

3 . . . Reactions in Metal Corrosion

a. Anodic reaction.

(1) Metal ions are released to the solution, in order of the galvanic series for the environment.

(2) Each ion carries one or more positive charges depending on the valence of the metal element.

(3) At the time of metal ion release to the solution, one or more electrons are liberated to the mass of metal.

(4) The anodic reaction takes place entirely at the surface of the metal.

b. Cathodic reaction.

(1) If electrons, released when the ion goes into solution, were to accumulate in the metal mass, a negative charge would build up high enough to prevent the release of more positive metal ions, by the simple force of electrostatic attraction.

(2) Buildup of negative electrons in the metal is prevented by the reaction of electrons with hydrogen ions in water to form hydrogen gas.

$$2H^+ + 2e^- \rightarrow H_2 \text{ (gas)}$$

(3) Since electrons are free to travel in the metal mass, this reaction can take place at some distance from the point where the metal went into solution.

(4) If corrosion takes place in a strongly acidic solution, the hydrogen gas bubbles can be seen to form on the metal surface and break away.

c. Depolarization.

(1) If the hydrogen film on the surface of the metal were not broken in some manner, it would protect more metal ions from going into solution. This is termed polarization.

TABLE 2

Galvanic Series of Metals

Corroded end (Anodic) ↓	Magnesium
	Zinc
	Aluminum
	Steel or iron
	Cast iron
	Lead
	Tin
↑	Brass
Protected end (Cathodic)	Copper
	Bronze

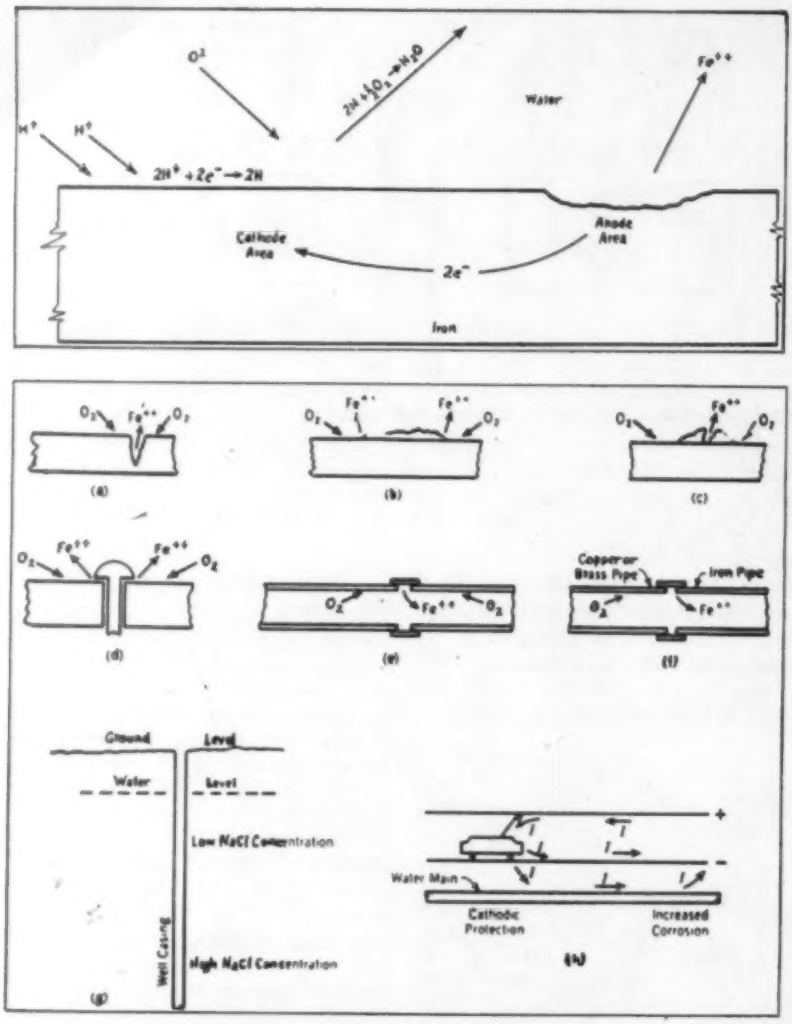


Fig. 2—Typical corrosion cells (After Eliassen and Lamb)

Above—Corrosion cell on surface of submerged iron; the surface of a large section of metal may be covered by many such cells.

Below—Corrosion cells found in practice—Key—(a) pit or depression, (b) mill scale or corrosion product, (c) biological growth, (d) rivet or bolt, (e) pipe coupling (same metal), (f) pipe coupling, (dissimilar metals), (g) well casing in water of varying salt content, (h) stray current corrosion. The first five are examples of differential-aeration cells; the other three are, respectively, galvanic, concentration, and impressed-current cells.

(2) In strong acids the hydrogen gas is removed by the mechanical action of the formation of large bubbles which break loose from the metal surface.

(3) In very weak acids or in water, the hydrogen can be removed by other mechanisms and never appear as a gas. This is termed depolarization.

(4) The presence of hydrogen acceptors will remove the hydrogen gas as fast as it forms.

. . . One of the best hydrogen acceptors is oxygen dissolved in water. This reaction takes place:

$$2\,H_2 + O_2 \rightarrow 2\,H_2O$$

d. Reaction of metal ions.

(1) Most metal ions which go into solution will react with other ions in water or with water itself or with oxygen dissolved in water.

(2) Some of these reactions result in impervious coatings which protect the metal against further corrosion.

. . . Basic zinc carbonate in one example.

$$5\,Zn^{+} + 6OH^{-} + 2\,CO_2 \rightarrow 2\,ZnCO_3 \cdot 3\,Zn(OH)_2$$

. . . Aluminum oxide is another example.

$$2\,Al^{+++} + 6\,OH^{-} \rightarrow 3\,H_2O + Al_2O_3$$

(3) Other compounds formed by reaction of the metal ions are highly pervious and have no value as a protective coating. Iron rust is of this type.

$$2\,Fe^{++} + \tfrac{1}{2}O_2 + 4\,OH^{-} \rightarrow 2\,H_2O + Fe_2O_3$$

or

$$2\,Fe^{++} + \tfrac{1}{2}\,O_2 + 4\,HCO_3^{-} \rightarrow 2\,H_2O + 4\,CO_2 + Fe_2CO_3$$

and

$$3\,Fe + 4\,H_2O \rightarrow Fe_3O_4$$

(This latter reaction does not occur to any extent at normal temperatures).

4 . . . Corrosion Cells

a. Metals grouped closely in a galvanic series do not tend to form galvanic cells, but metals widely separated in the galvanic series will form galvanic cells.

b. Of the many kinds of electrolytic cells capable of causing corrosion, there are four of particular importance in water works practice. Three of these are illustrated in Fig. 1.

(1) Impressed-current cells wherein a flow of electrical current between two electrodes causes a solution of the metal at the anode in direct relation to the amount of current passed.

(2) Galvanic Cells in which two different metals having different emf potentials are connected in some manner thereby causing a flow of electrical current with consequent solution of the metal of lower emf potential (the anode in this case).

(3) Concentration cells in which two electrodes of the same metal are immersed in solutions of different concentrations of the metallic ion.

. . . In this case the metal in the stronger solution has the higher solution potential and it acts as the cathode. The current will flow between the two electrodes and the metal immersed in the weaker solution will act as the anode and will go into solution until the concentrations and potentials become the same.

(4) Differential-aeration cells in which one electrode receives more oxygen than the other and therefore depolarizes faster.

. . . More rapid removal of the hydrogen at one electrode aids in the transfer of electrons from the metal at that point and this electrode becomes the cathode, while the other electrode (with less oxygen present) becomes the anode and goes into solution.

(5) Other types of corrosion cells are those set up by differential temperature or differential stress in metals, but these appear to be of lesser importance in water works practice.

c. These four types of corrosion cells, mentioned above, have been described as though the electrodes were two different pieces of metal but any

one of these cells can become a reality in a single piece of metal in contact with water, as for example a water main, or an elevated storage tank, or a house service.

(1) Corrosion cells on the surface of the metal may be set up by differences in metal composition, by differences in concentration of solution, by differential aeration, by connecting metals of different composition to each other, or by impressed stray currents. (See Fig. 2).

(2) Since corrosion cells can exist for a variety of reasons, it is understandable why corrosion of metal surfaces is not always evenly distributed but instead occurs in many localized areas giving rise to pitting.

. . . Protective action against corrosion may likewise be effective over local areas and thus also prevent corrosion from being equally distributed over the entire metal surface.

C . . . Measuring Corrosion

1 . . . Purpose of Determination

a. The determination of the extent of corrosion in a distribution system is important for several reasons.

(1) To ascertain the effect on carrying capacity of mains.

(2) To provide proper maintenance.

(3) To answer customer complaints.

(4) To determine the need for corrective treatment of the water supply.

b. Measuring corrosion after corrective treatment is important to determine the effectiveness of the treatment.

2 . . . Methods Available

a. There are five methods of making quantitaitve determinations of the extent of corrosion in a distribution system.

(1) Determine loss of weight of metal over a period of time.

(2) Determine the depth of pitting during a time interval.

(3) Determine the change in coefficient of friction for a pipe line.

(4) Note frequency of need for meter overhaul or incidence of household fixture failure.

b. The first two methods can be accomplished in the laboratory with strips of metal immersed in the water under study.

(1) It should be remembered that in the field, water is not in contact with air and it moves at some velocity, not constant.

(2) The simulation of field conditions in the laboratory is possible but not always easy.

c. The third and fourth methods mentioned require observations over a considerable period of time.

d. The last method involves the analysis of water at two or more points on the system to determine the possibility of pickup of metal ions. This method is especially useful in answering customer complaints and may prove to be quite helpful in the study of the corrosive action of water within a household piping system.

(To be continued. The second part of this lecture will deal with methods of preventing corrosion. References will be appended to the next installment.)

A "gadget" for
Properly Socketing Cast Iron Pipe

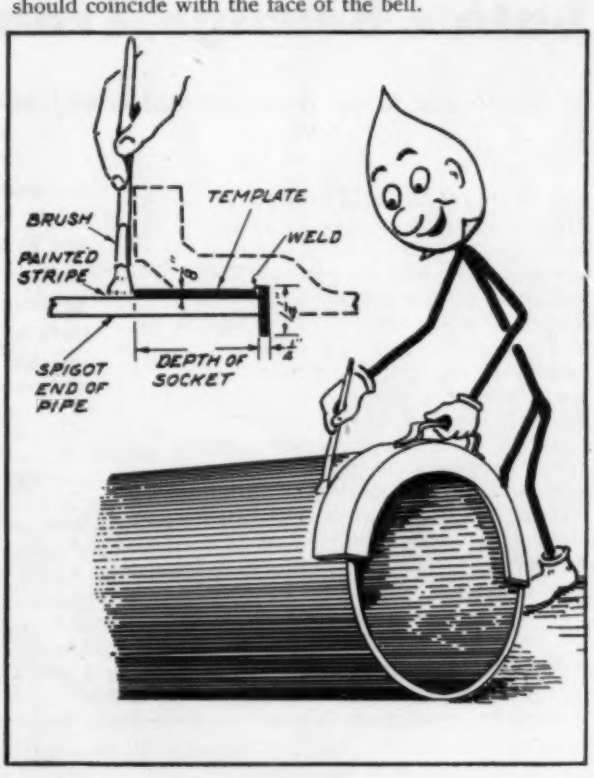
Contributed by ROY RUGGLES, Chief Engr. of Const.
Atlanta Water Dept., Atlanta, Ga.

Responding to a request from the Editor of *Water & Sewage Works,* "Willing Water" is happy to offer this contribution as a possible benefit to his many brothers in the water supply field.

A little "gadget" that we in Atlanta have devised for insuring the proper socketing of cast-iron pipes in water main construction has proved to be of great help to our inspectors and the pipe laying foremen. Its use precludes the necessity of crawling through the pipe to see that the pipe has been properly socketed, and driven home before the joint is made up. Another advantage is the insurance of a joint of greater tightness.

A template is made by bending a piece of ⅛-inch thick flat steel to conform to the outside diameter of the pipe making a half hoop. The width of this piece is to be exactly the depth of the pipe socket. A strip ¼ x 1¼-inch steel is then formed so that the edge will be of the same curvature as the ⅛-inch half hoop piece. The two pieces are then welded together as shown on the accompanying drawing; this will give you a curved angle which will fit snugly but not binding on the spigot end of the pipe. For convenience in placement and lifting, a handle is welded on the central portion of the template. This is all—your "gadget" is complete and ready for use.

All that is now needed is a can of light colored paint, a small brush and a laborer to stripe the spigot ends of the pipe while they are lying along the route of the main. It is only necessary to stripe the upper half of the spigot end of the pipe, as this is sufficient to indicate its position in the bell. That is, the front edge of the paint stripe should coincide with the face of the bell.



ENLARGED Luton sewage treatment plant combines a ctivated sludge, trickling filters, and effluent filtration

Ten Years Operation and Development at

Luton, Sewage Treatment Works

In which the latest development is effluent straining

by S. C. EVANS

Mr. Evans is Engineer and Manager of the Luton Corporation Sewage Department, East Hyde, Luton, England. **In this article he describes the developments leading to the present use of both activated sludge and trickling filters, plus effluent polishing by "Micro-straining" and rapid sand filters.**

MANY LOCAL AUTHORITIES in the United Kingdom are experiencing increasing difficulties in treating their domestic sewages and industrial wastes and producing effluents of satisfactory quality. These difficulties emanate in the main from several causes, such as increased water consumption for domestic and industrial purposes, more industrial waste of an inhibitive or toxic nature, the presence of synthetic detergents in increasing quantities, the increasing pressure of river boards for effluents of better quality, and the difficulty of finding the necessary financing to undertake large construction of the purification works which are required.

In certain cases legal actions have been taken against Local Authorities. Sometimes damage or nuisance has been proved against the Authority and substantial claims have had to be met, as well as the legal costs and the costs of complying with the judgment. These difficulties will probably increase in the future and Authorities no doubt will be looking to those who have had experience of this kind to know how to deal with such problems. Therefore, the experience gained at Luton, Bedfordshire, may be of interest.

The Luton Corporation engaged a leading firm of consulting engineers to design and supervise the construction of a completely new sewage works, which was started in 1938 and completed at a cost of nearly 500,000 pounds in 1946. These works proved to be well constructed, of adequate capacity and well-designed, but in spite of this a legal action was brought against the Corporation in 1948 and judgment was given against the Corporation.

It was therefore necessary to take further steps to improve the quality of the effluent discharged into the river, which at best provides very little dilution, and at times none at all, to the 7 m.g.d. of effluent. Although no specific standard was laid down

for the quality of the effluent, it was demanded that the river nine miles below the point of discharge and receiving no other dilution should create no nuisance and maintain trout. A program of research and development was undertaken covering three lines of attack—reduction of load, increased efficiency, and development of new processes. The results of these activities can be seen and assessed in this brief report.

Reducing The Plant Load

The load arriving at the sewage works has been considerably reduced by control of industrial discharges, particularly those containing metals and other inhibitory constituants. Charges have been made on a volumetric basis. When the position was fully explained to the industrial contributors and the gravity of the effects was appreciated, good cooperation was obtained.

The outstanding difficulty to date has been the local Gas Board, which has large internal extensions to carry out for the manufacture of increasing quantities of gas. The discharge of effluent from this source into the sewers will be one of the problems dealth with. There is no doubt that the effluent from the manufacture and purification of gas has been a source of trouble to both Gas Board and Local Authority officials. Much work has been done and it is hoped that a solution of this particular problem will be found in the near future.

TABLE I
Cost of Sewage Treatment at Luton

Year	Total Cost,* £	Sewage Rate,* s.	d.
1948-49	78,341	2	1.73
1949-50	78,377	2	1.39
1950-51	78,222	2	0.87
1951-52	88,192	2	3.31
1952-53	85,888	2	2.13
1953-54	96,365	2	4.76

*Cost figures given in British currency—To convert to U. S. currency—£ = $2.80 s = $0.14 d = $0.01.

Another reduction of the load going to the biological processes was obtained by changing the method of sludge treatment from heat treatment and filter pressing to chemical conditioning and filter pressing. Although such drastic measures may not have been necessary under more normal conditions, the results required at Luton justified the action taken. The following is a resume of the general modifications on the sewage works.

Modification of the Sewage Treatment Works

The screens originally built at the inlet to the sewage works comprised a pair of horizontal perforated screens in separate channels cleaned by traveling suction disintegrators. This equipment never operated successfully and was replaced by Dorr screens using the original disintegrators. This equipment has worked well for a number of years, the only criticism being that due to the screens being upstream of the grit channels the wear on the cutters has been on the high side. This has been reduced by fitting a time control on the disintegrator so that it is only operated as and when required.

As an experiment, screenings were sluiced from the screen troughs onto adjacent land. The settling tanks were soon much cleaner in appearance, and debris which often penetrated through the works as far as the activated sludge effluent, was reduced. When the amount of screenings removed had reached about 50 cubic yards, the amount of decomposition was equal to the amount arriving. This suggests that where sludge digestion is practiced it probably would be beneficial to pass the sewage through fairly fine screens and pass the screenings direct to the sludge thickening tanks or digesters, with general benefit. As sludge digestion is not used at Luton, this cannot be done.

Following screening the sewage passes through two grit channels of the contsant-flow type, which have been most satisfactory. An unusual feature is that the channels by nature of the site are elevated and the grit is removed through two gates in the base of each channel after the water has been drained off. This operation

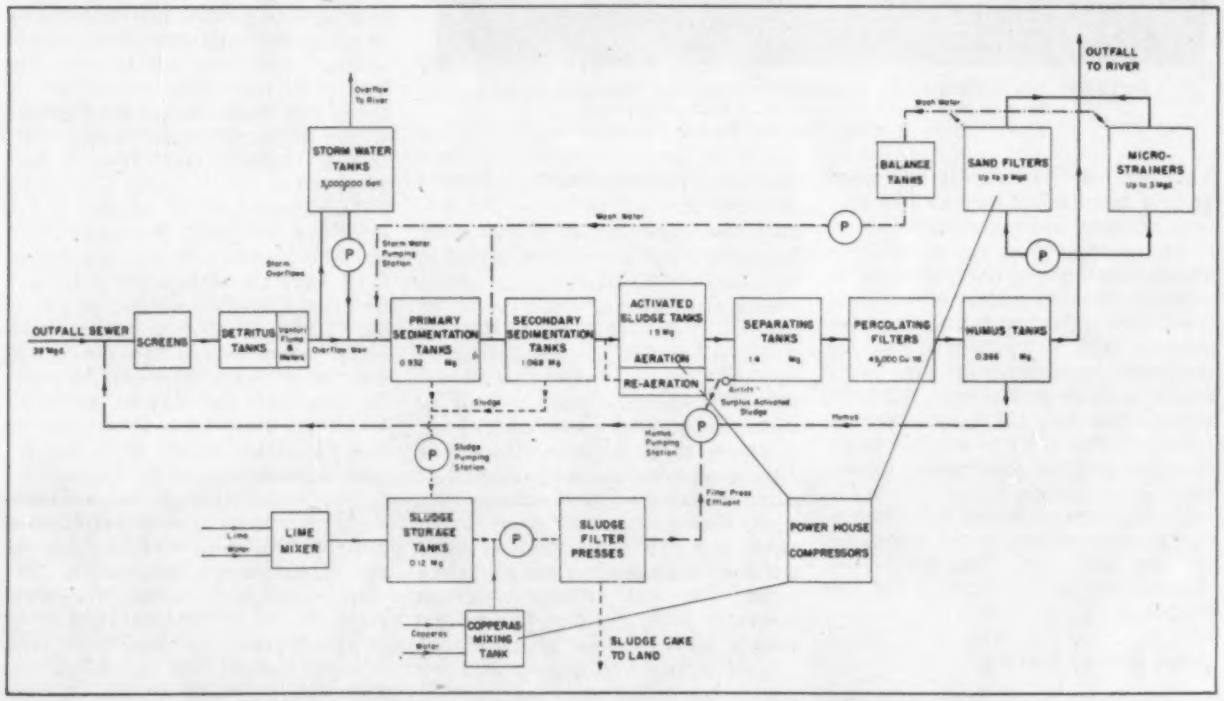


Fig. 1—FLOW DIAGRAM of sewage treatment works of Borough of Luton

EFFLUENT POLISHING is by rapid sand filters and "Micro-straining"
Upper photo—Filter building at left of final settling tanks
Lower photo—"Micro-straining" equipment housed in metal building

is carried out twice weekly and clean grit is removed. The procedure is both efficient and economical.

The sewage then passes along a channel with a long overflow weir to separate flows in excess of 16 mgd. into rectangular storm tanks, the original capacity of which was 2.4 mg., now extended to 3 mg. With this capacity (equal to about 10 hours dry weather flow) it is only on rare occasions that there is any discharge from the outlet of these tanks into the river. Examination of the river after such discharges indicates that no serious harmful effects to the biological life take place even when there is no natural flow of water to dilute the discharge.

Series Primary Settling

The normal flow through the works passes into two stages of settlement having an over-all capacity of 2 hours retention at maximum flow. The primary tanks are circular in plan, with radial flow and a retention period of 40 minutes. The secondary tanks are rectangular, with a retention of 80 minutes at maximum flows. Because both types of tank are subject to short circuiting at maximum flows, consideration has been given to bringing them into parallel operation. So far, however, there is no evidence that there would be any improvement. It may be that the circular tanks give good flocculation and some settlement, and any flow which is short circuited is retained in the secondary tanks. The tank effluent compares favorably with the top liquor from sewage settled in the laboratory.

Care is taken to balance out any return liquors as much as possible. The liquor from the sludge filtration plant, which has been found to have no detrimental effects, is mostly returned in the periods of high flow. Secondary sludges from the activated sludge process and filter humus (also washings from sand filters and microstrainers to be discussed later) are returned to the plant inlet. There is a tendency for the solids in these flows to rise to the surface of the tanks, but the effect on the tank effluent is not serious. However, as a general practice it has been found preferable not to return excess activated sludge to the primary settling tanks, but to treat it by other means.

The Activated Sludge Process

After primary settlement the sewage is treated in an activated sludge plant of the conventional diffused air type. The original capacity of the aerators was 4 hours, now extended to 5.6 hours.

Two-thirds of the aeration tanks are used for aeration and one-third for return sludge reconditioning. The plant is essentially a bio-flocculation and partial aeration plant. Nitrification does not take place. It has been found beneficial to pump nitrified effluent from the trickling filter beds into the reconditioning section of the activated sludge process and arrange to bypass all flows of more than 12 mgd. of primary tank effluent direct to the filter beds. By this means shock loads on the activated sludge process are evened out and the plant works at maximum efficiency.

The sludge recirculates at the rate of 3 mgd. by air lifts and recently by an additional axial-flow pump, which is more economical of power. The benefit of high recirculaiton is thought to be due to quicker removal of the sludge from the sludge separating tanks, rather than to any other effect.

The amount of air pumped is 0.7 cubic feet per gallon of sewage treated. The activated sludge separating tanks have a total capacity of 15 mg., equal to 2 hours retention at maximum flow. This capacity has been found adequate; in fact, in warm weather it is usual to reduce the number of tanks in operation by one-third, which has the effect of increasing the rate of sludge return from the remaining tanks.

The condition of the activated sludge is subject to considerable variation, but the work done by the process is considered satisfactory. The surplus activated sludge is concentrated in one of the separating tanks before removal for treatment. The original method was to decant approximately 100,000 gpd. to the sewage inlet, but it was found that a

TABLE 2

Cost of Treatment During 1953-4

Item	Screening and Tanks			Humus and Filter Beds			Aeration			Sludge Treatment			Micro-Strainers			Sand Filters			Total		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Wages	1,522	7	6	493	19	10	2,965	0	10	7,848	10	6	34	6	2	511	1	1	13,375	5	11
Transport										3,169	10	1							3,169	10	1
Lime										6,285	18	2							6,285	18	2
Copperas										1,050	15	5							1,050	15	5
Levozone													124	10	0				124	10	0
Tools				50	0	3	29	3	3	11	14	5							90	17	11
Rep. and Maint, Bldg. and Tanks	94	7	0				111	2	3	24	16	6							230	5	9
Maint., mech.	602	18	11	45	16	8	200	10	9	586	10	2	277	19	0	183	0	2	1,896	15	8
Press Cloth										2,211	3	5							2,211	3	5
Power, elec.	453	17	4	1,000	0	0	4,782	7	5	408	12	5	271	12	0	856	0	8	7,772	9	10
Total	£2,673	10	9	1,589	16	9	8,088	4	6	21,597	11	1	708	7	2	1,550	1	11	36,207	12	2

Cost of sludge treatment per 1,000 gallons=£1 1s. 10d. for 19.773 mg. of sludge.
Cost of sewage treatment per 1,000 gallons=3.1d. for 2,793.79 mg.
Total annual cost=£96,365=7.1d. per 1,000 gallons.

large part of this came through the primary settling tanks back into the activated sludge plant. It also had a very bad effect on the sludge treatment process. It appears that activated sludge in good condition will both settle and filter reasonably well, but when returned to the non-aerobic conditions in the sewage these favorable characteristics of the sludge are lost.

Trickling Filter Treatment of Activated Sludge Effluent

The effluent from the activated sludge plant passes to rectangular filter beds containing 45,000 cu yd of clinker media 6 feet deep. The rate of application is 150 gpm, per cubic yard, with a maximum of three times that rate in times of storm. The traveling machines (distributors) are driven by the applied liquor. They have been modified to give a dose on an average of once every 10 minutes, but the period of rest is twice as great at the ends of the beds as it is in the center. Recirculation of effluent is carried out at low flows in order to keep the machinery moving satisfactorily.

Some of the beds contain graded media; others contain media of large size which is not graded. The graded media give a higher degree of nitrification, but the difference is only slight. In experiments to ascertain the maximum loading which can be applied it has been found that the loading can be increased by as much as 30 per cent with no deterioration of the effluent. Flushing the media for a few hours at as high a rate as possible removes large quantities of sludge from the media and the effluent afterwards is of a very high quality.

Final Settling and Effluent Polishing

The effluent then passes through shallow rectangular humus tanks with less than 1 hour retention at average flow. This part of the plant is considered to be insufficient. Consideration has been given to improving or replacing these tanks, but after a considerable amount of research it was decided not to incur any further expenditure but to install additional processes which would insure much better results. The humus tanks remove above 50 per cent of the suspended solids from the filter effluent and have to be emptied daily.

The additional processes are rapid sand filters and micro-strainers, the two processes being in parallel.

The three micro-strainers deal with 2.5 mgd. of effluent and have been in continuous operation, except for a partial overhaul period of three weeks since they were installed in 1950. The flow passes the Micro-strainers by gravity, as the maximum head required is only 9 inches, and the power consumption is very low. The machines are chlorinated for an hour once a week. This is practically all the attention they get except for an occasional topping-up of the oil in the gear boxes.

Over the years the strainers have reduced the suspended solid content of the effluent from 17 to less than 9 ppm., with a considerable reduction in the biological oxygen demand. The use of Micro-strainers for the treatment of sewage effluent was a new departure at the time (1950) they were installed at Luton, but experience has shown that they can do a

TABLE 3

Summary of Annual Average Analysis of Liquor Entering and Leaving Biological Purification Plant, 1948 to 1954

Year	Daily Flow, mgd.	4-Hour Permanganate Absorption, ppm.				5-Day B.O.D., ppm.					
		Tank Effl.	Activ. Effl.	Humus Effl.	Final Effl.	Sewage	Tank Effl.	Total in Tank Effl., lb.	Activ. Effl.	Humus Effl.	Final Effl.
1948	5.3	66	41.8	19	—	351	250	13,250	130	27.3	27.3
1949	5.28	63	38.9	17.9	—	347	157	8,320	86	23.3	23.3
1950	4.93	59.3	34.5	15.7	—	305	152	7,450	62.5	16.4	16.4
1951	6.86	48	28.4	11.5	8.3	294	113	7,680	46	15.0	8.3
1952	8.05	40.7	20.1	7.5	6.7	300	116	9,330	41.3	14.3	7.8
1953	7.2	43.7	21.2	9.5	8.1	340	146	10,330	55.9	14.2	8.8
1954	7.6	45.5	22.4	8.6	7.8	261	125	9,500	40.4	11.0	6.6

very useful job of removing suspended solids and the claims of the manufacturer (Glenfield & Kennedy) have been more than fulfilled.

Nine sand filters of the rapid gravity type have been installed, with a maximum through-put of 1 mgd. each at 200 gallons per square foot per hour. These, too, have given every satisfaction. It has been found, however, that a rate of 150 gallons per square foot per hour gives the maximum removal of solids. It is necessary to pump the effluent through an average head of 7 feet and to backwash the filters once each day. The solids content is reduced from 17 to less than 5 ppm. and the B.O.D. by a similar amount.

Modifications have been made to the pump control mechanism in order to co-ordinate the pumping rate with the capacity of the filters. This has resulted in better efficiency and a higher removal of solids. The plant has been in continuous operation since 1951 and, except for recovery of sand from the waste water tanks and normal electrical maintenance,

SLUDGE is filtered in presses and hauled for use on nearby farm land.

ating costs in Table 5.

There has been some loss of sand from the top of the filters which indicates that a freeboard of 12 inches or more is necessary above the sand. This has in no way impaired the efficiency of the filters.

The amount of backwash used to clean the filters and the micro-strainers is approximately 3 percent of the throughput.

As will be seen from the cost figures the cost of removing suspended solids in the plants is about equal. The cost of removing B.O.D. shows in favor of the sand filters as biological purification takes place in the sand.

The cost per million gallons treated shows in favor of the micro-strainers.

All these figures are overwhelmingly affected by loan charges.

TABLE 4

Operating Results in ppm—1956

	Humus Tank Eff.		Micro-Strainers.			Sand Filters.			
	O.A.*	B.O.D.	S.S.	O.A.*	B.O.D.	S.S.	O.A.*	B.O.D.	S.S.
Jan.	8.3	13.4	13.2	7.3	10.1	5.2	6.6	5.7	4.0
Feb.	8.7	13.3	16.0	7.3	8.9	9.0	6.8	7.1	6.1
March.	9.4	14.5	17.9	8.4	10.9	9.2	7.7	8.2	7.1
April.	7.4	8.5	12.1	6.5	7.0	7.0	5.7	4.1	3.8
May.	6.6	5.9	6.8	5.1	5.0	3.7	5.1	2.8	1.4
June.	7.0	7.4	13.3	5.7	4.7	4.2	4.8	2.9	2.1
July.	7.7	7.0	15.2	6.6	4.6	6.4	5.5	2.5	2.4
Aug.	6.6	7.2	14.1	5.5	4.7	5.7	4.5	2.6	3.3
Sept.	6.8	7.6	11.3	5.8	4.3	4.4	4.6	2.4	1.0
Oct.	6.5	9.1	12.2	5.4	5.5	4.2	4.6	2.5	1.2
Nov.	7.4	8.3	15.6	6.5	7.0	8.6	5.8	3.8	2.5
Dec.	7.0	8.6	13.4	6.4	7.1	8.6	5.6	3.7	4.4
Total:	89.4	110.8	161.1	76.5	79.8	76.2	67.3	48.3	39.3
Average:	7.45	9.2	13.4	6.3	6.6	6.3	5.6	4.0	3.3

*Oxygen absorption from permanganate

there have been no difficulties. It would be more economical to use raw water for backwashing the filters, rather than filtered water. Tests with a pilot plant have shown that there are no drawbacks to doing this, but it is not possible with the present arrangement at Luton.

The over-all effects of the changes mentioned will be appreciated by reference to the performance and cost data as given in Tables 1, 2, and 3.

Operation of Final Straining 1956

The nine sand filters and the three micro-strainers were worked continuously throughout 1956. The sand filters passed 1,920 million gallons and the micro-strainers 781 million gallons. The average analytical results are shown in Table 4 and the oper-

Sludge Treatment

In producing effluents of higher quality increasing difficulties were created with the treatment of the sludge. The original sludge treatment plant comprised heat treatment to a temperature of 370°F., with heat recovery, and filter pressing using plate-and-frame presses. Very few of these plants had been built and considerable mechanical "teething" troubles were met. But gradually these were overcome until the process was working nicely. Some 250 tons of mixed sludges per day were being put through the plant. The end product was 5 tons of ash or 15 tons of semi-dry sterilized fertilizer, which was in good demand. It appeared, however, that the liquor from the sludge plant had some adverse effect on the effluent discharged into the river and the heating process was replaced by chemical conditioning. Ferrous sulfate, a byproduct from a local chemical works, and lime are added to the sludge, which is then filtered in the presses. A trial period of three years demonstrated that the process was suitable for the Luton conditions and the process has been in operation since 1949.

The pressing plant is so arranged that the cake discharges directly into agricultural trailers and it is distributed on local farmland, the farmer paying for hauling and spreading. The amount of lime (ground burned) is 1.5 per cent of the total liquid sludge and the ferrous sulfate 0.75 per cent.

The presses are automatically fed by Mono (screw type) pumps working up to a maximum pressure of 100 psi. The output is 60 tons a day and, due to the high lime content, there is a good demand. Since the surplus

TABLE 5

Operating Costs—Micro-Strainers and Sand Filters. 1956.

	Micro-Strainers.	Sand Filters.
Wages. Operating.(1)	£36(2)	£703(2)
Chemicals	96	—
Plant Maintenance.	37	105
Electric Power.(3)	293	907
Loan Charges.	1093	3700
Total:	£1555(2)	£5415(2)
Cost per million gallons.	£1.991	Cost per million gallons. £2.862
20,306 lb B.O.D. removed		99,840 lbs B.O.D. removed.
= £.076 per lb removed. approximately 1/6d		= £.0542 per lb removed. approximately 1/1d
Cost per pound Suspended Solids removed = 6½d		Cost per pound Suspended Solids removed = 6½d

The amount of backwash in each case is approximately 3 per cent

(1) Labour at 3/10¾d per hour.
(2) £ = $2.80
(3) Electricity at 1.12d per unit.

activated sludge increases the filtering difficulties, for the past year this sludge has not been filtered but has been concentrated in the separating tanks and distributed in fluid form directly to the farms. No charge has been made for this pending the results on the crops. From a survey by the local agricultural people it is estimated that the productivity of the land treated with the lime treated sewage sludge is about 20 per cent higher than that which has not been so treated.

The improvement in the condition of the river as a result of these activities is, as one would expect, very marked. Nevertheless, the appearance still leaves much to be desired, due to excessive foaming at weirs due to the detergent residues (3 ppm.) and the brown tint which is associated with the gas liquor. Two miles below the outfall the river contains 66 per cent oxygen (minimum 55 per cent); five miles below, 80 per cent (minimum 66 per cent).

Twenty miles below the outfall, the water in the river, after having received some dilution, is extracted for purification and used as drinking water.

ASCE Spring Convention To Be Held in Buffalo, N. Y.

The 1957 Spring Convention of the American Society of Civil Engineers will be held June 3-7 in Buffalo, N. Y., and in addition to the technical program, a special trip to the St. Lawrence Seaway and Power Project is planned.

The Program Committee of the Sanitary Division has scheduled three sessions for the convention. On Wednesday afternoon, June 5th, the subject of Stream Pollution in the Great Lakes Area will be discussed. Arrangements are being completed for the presentation of four papers by F. P. Coughlan, H. W. Streeter, Raymond Hess and Dr. A. E. Berry.

On Thursday morning, June 6th, the program will be devoted to papers on water intake design and construction in the Great Lakes area. The Thursday afternoon session will be taken up with the subject of Sewage Treatment for several Great Lakes cities.

The cost of the special St. Lawrence Tour, including transportation, sleeping accommodations, and meals en route, will amount to approximately $35.00 per person. The tour will start early Friday Morning, June 7th and return to Buffalo approximately 9:00 A. M. Saturday, June 8th.

Aruba, Curacao, Building Electric Water Distilling Plant

Aruba, Curacao has begun construction on a complex $10-million plant to produce electricity and chemicals and to distill water.

Utilizing cheap fuel from one of the world's largest refineries to operate high-pressure steam turbines, the plant will have a capacity of 12,500 kilowatts. Runoff steam from the turbines will retain sufficient pressure to evaporate 10,000 metric tons of sea water daily—a total of 2.7 million gallons. This water is expected to cost only about half of the current rate for similar water.

Electricity and pure water from the plant will be used to produce chemicals from the residue left after the distillation process. Very pure quartz is native to the island and will be used in chemical production together with the minerals extracted from sea water.

Dr. Wolman Resigns as Dept. Head at Johns Hopkins

Prof. Geyer Assumes Position

Dr. Abel Wolman, widely known in the water and sewage field as a consultant and Chairman of the Department of Sanitary Engineering, at Johns Hopkins University, has resigned his administrative duties at the university. He will continue as a member of the faculty, however, as Professor of Sanitary Engineering.

Dr. Wolman

Dr. Geyer

Dr. Wolman is approaching the university retirement age, but plans not only to continue teaching but to continue his many other activities as a consultant and advisor to several boards and committees.

Dr. John C. Geyer succeeds Dr. Wolman as head of the Department. Dr. Geyer is an engineering graduate from Michigan, with a masters degree from Harvard and a doctorate from Johns Hopkins. He has been at Johns Hopkins since 1937, except for World War II service. Dr. Geyer is best known for his co-authorship with Dr. Gordon Fair of the outstanding text "Water Supply and Waste Water Disposal."

Rutgers Sanitation Department Matriculates First Distaff Graduate Student in 15 Years

Miss Marjorie Harrison of Acrefair, Wrexham, Denbighshire, North Wales, has become the first female graduate student to enroll in Rutgers University's Department of Sanitation, in 15 years.

Miss Harrison majored in bacteriology at the University of Wales in Cardiff and later went to work for Monsanto Chemicals Ltd., England. Her interest in graduate work stemmed from working at the Monsanto plant, which is located on Welsh Dee River where salmon fishing is very important. Universities in Great Britain do not offer such graduate training.

Working on a Rutgers fellowship, Marjorie Harrison is a star student, according to Dr. Heukelekian, professor of sanitation, who has urged Marjorie to stay to study for a Ph.D. But she feels she must get back to problems on the Welsh Dee.

Chicago to Try Zimmermann Process to Dispose of Sewage Solids

The Chicago Sanitary District and Sterling Drug Inc., have jointly undertaken a cooperative field project to test the Zimmermann "Wet Combustion" process for the treatment and disposal of sewage solids.

The end products from the Zimmermann Process are water, with an acceptable chemical oxygen demand, and a small amount of non-offensive ash.

The research contract calls for Sterling Drug to assume all costs of construction of a pilot plant and installation of equipment, and to furnish supervisory and technical personnel to operate the plant. The purpose of the test will be to evaluate the cost of "burning" sewage sludge in various concentrations from 2 to 6 percent or more, and to provide information regarding the economic value of the wet oxidation process in comparison with other methods now in use.

A SMALL PORTION of the quantities of sand and cinders removed from the sewers serving the Aurora business area

Use of Outside Forces Cuts Sewer Cleaning Costs

by GEORGE ORLAND
Commissioner of Public Property
Aurora, Illinois

SEWER RODDING and cleaning by contract forces has been found by Aurora, Ill., to be appreciably superior to having city crews do that type of work.

Last year a Chicago contractor, National Power Rodding Corp., rodded and bucketed eight miles of heavily clogged storm and sanitary mains in Aurora, a city of 56,000 located near Chicago. In far less time—and at far less cost—than the city's own forces would have needed for the job, the system's operating efficiency was markedly improved.

Actually, if an outside sewer cleaning contractor had not been hired it is quite likely that the sewer system would today be worse than ever. Like most communities, Aurora has a sewer maintenance crew and some specialized equipment available for removing blockages. However, both were fully occupied handling routine service complaints. To undertake the much more ambitious task of cleaning long sections of sewer line which hadn't received any attention, for the most part, since they had been laid 50 to 75 years previously, would have meant neglecting the bulk of the service calls. Even then, task of over-all sewer rehabilitation almost certainly would have taken years because of the limited capacity of the rodding machine and the small size of the maintenance crew.

Delay Would Have Been Costly

Delay was a luxury that could hardly be afforded, however, for in May, 1956, when the contractor went to work, the many problems created by the blocked sewer lines had assumed the proportions of much more than a mere nuisance. Property owners along Aurora's main north-south thoroughfare, Broadway, were among the major sufferers.

Under a part of this important business artery, extending four blocks from Spring Street to Benton Street, are some 1,800 feet of submain ranging from 15 to 24 inches in diameter. Approximately midway along this 1,800-foot section, at Main Street, there is an overflow line designed to carry excess storm water to the Fox

River nearby. Another overflow line runs under Benton Street.

At Benton Street the sanitary sewer connects with a 36-inch trunk line that runs west to the river, approximately 500 feet away. This trunk feeds into a 54-inch main interceptor under the river that transports sewage to the treatment plant, which is approximately four miles farther south.

The seriousness of the blockage in this part of the system is illustrated graphically by the fact that at the time cleaning operations began the flow from the Broadway submain into the Benton Street trunk produced a sewage depth of only 4 inches in the latter sewer. More important, every time there was a storm, the flow from the Broadway submain would back up into adjacent basements and onto the street. Inasmuch as the contents of this sewer consisted of both sanitary and storm flows, the blockage was particularly irritating to those affected.

This was only a part of the problem. Besides backing up into basements and onto the street, the contents of the Broadway submain also would rise above the 18-inch gates at the entrance to each overflow main, causing raw sewage to run off into the Fox River. Whenever this contamination occurred, both the City Hall, and the sewer department would be besieged with complaints from local sportsmen, plus a number of other citizens and groups.

Besides Broadway, there were several other "tender" areas. It was seldom that even a moderate storm didn't produce backup of sewage into at least a couple of hundred residential basements throughout the city. Many times, water to a depth of 3 or 4 inches would be left standing on residential streets. Occasionally, the backup would be so great that it covered lawns and sidewalks.

Complaints Ceased

The success of the effort to restore the system to efficient operation is indicated by the fact that since September 1956, when the contractor finished his assignment after approximately four months work, the sewer department hasn't had one complaint from the areas in which sewers were cleaned. The previous winter there had been some 300 complaints from the four-block area along Broadway alone. Flow tests in the lines that have been cleared show that flows are now five to ten times greater than before the cleaning.

Cost of the job, which consisted of 41,126 feet of 8-inch to 48-inch main, came to approximately $25,000—considerably less than had originally been anticipated. In the course of their operations, the rodding crews removed more than 300 cubic yards of debris. More than 30 cubic yards came out of the Broadway submain, and more 22 cubic yards from the Benton Street trunk running to the river. The material removed from these and other lines consisted mainly of sand and cinders, heavy tree roots, and sludge.

THESE THREE ROOTS were responsible for a serious blockage in a residential area

The decision to use outside forces was predicted upon a realistic appraisal of both the seriousness of the problem and the city's capacity to alleviate it with its own forces. For equipment the department had a ¾-hp rodding machine; for manpower, a four-man crew.

Problems of Serious Blockages

The available rodding rig is an excellent piece of equipment, but it has definite limitations. For one thing, when serious blockages are encountered the auger must be backed off and run into the obstacle repeatedly in order to get through. Breakage of the ¼-inch diameter linkage that comprises the flexible rod connecting the auger with the drive motor is frequent and expensive. Because of these two problems, any over-all sewer cleaning program was bound to take more time than would be needed if more powerful equipment were used.

Even more important, however, was the fact that the available forces were already occupied full time taking care of service calls, cleaning catch basins, repairing manhole and catchbasin covers, etc. To saddle them with additional work would necessitate the purchase of more equipment and acquisition of extra manpower.

It was estimated that a bare minimum of $40,000 would be needed to acquire equipment and manpower capable of getting the most critically clogged sewers cleaned in a reasonable time, without jeopardizing the routine sewer maintenance work. This figure includes an allowance of $4,800 for each of the four men needed to operate the equipment, $5,000 for a second rodding machine, $1,700 for a pickup truck to transport the rig, $4,200 for a dump truck to take debris away after removal from the line, and approximately $10,000 for a garage to house the equipment. Also, it would be necessary to find the men to operate the equipment—an extremely difficult chore, since sewer cleaning is not

among the world's most appealing occupations.

Furthermore, after the work was finished the equipment would remain at least partially idle for several years until the time came to reclean the sewers. In effect, a good part of the investment would be wasted. Also, not included in the foregoing cost estimate are the costs of keeping the equipment in operating order, of training and familiarizing personnel with the job, and of interest charges on the funds needed for the initial investment. On top of all this, Sewer Superintendent Bates, already occupied full time, would have a wellnigh impossible load of additional work and responsibility.

Savings Considerable

Thus, bringing in an outside contractor saved a bare minimum of $15,000, and probably more. Also, other benefits were obtained. The contractor's rodding crew, since they are engaged full time in this exacting, highly specialized work, have more than the average amount of experience and ability—far more than the department would probably be able to obtain hiring on its own. Also, the contractor's equipment is considerably more efficient than what the city would have been able to obtain.

The contractor's patented rodding equipment, unavailable on the market, is manufactured in the company's own plant. Basically, it consists of specially-designed spiral augers that are attached to as much as 1,200 feet of continuous spring steel rod having a diameter of about ⅜ inches. Power is applied by a V-type, four-cylinder, 25-hp gasoline engine with fluid drive coupling.

The rod is housed in a reel which can be rotated forward or backward, permitting the auger on the end to move in either direction. The speed with which the auger moves forward, together with the speed at which it spins, can be precisely controlled. This feature of the equipment improves the efficiency of rodding by sharply reducing the possibility that the auger will damage the tile. The chance of the roding breaking, thereby causing resultant downtime and delay, is also reduced to a minimum.

Time Saved, Too

If the department were to rod Aurora's sewers with its own forces, it would be necessary in some cases to build temporary manholes because the department's flexible rod doesn't always reach from one existing manhole to another. The contractor's equipment, however, was able to clear up to twice as much line at a time. Thus, by utilizing an outside contractor, this expensive problem was avoided.

The increased power provided by a 25-hp, vs a ¾-hp, drive motor is also important. Virtually nothing, short of collapsed tile, prevented the contractor's augers from getting through a blockage. In the course of the last summer this fact was demonstrated on a number of occasions. There were several heavy blockages, involving tree roots, cinders, and hardened grease, which were cleared in 10 to 20 per cent of the time that would be required for the department's own equipment to do the same job.

The contractor also had bucketing equipment, which was used to clean each section of sewer line after it had been rodded. Aurora lacks a bucketing rig, relying only on flushing the line with a fire hose. This is far less efficient, because it removes only a part of the debris.

An important advantage of using a contractor for this work is that the works on a firm-price basis. As municipal engineers know, the difference between estimated cost of a cleaning job and final cost can be substantial. No matter how closely the cost is figured, something can happen to make it spiral upward. But by obtaining a firm quotation initially, as Aurora was able to do, this problem is effectively eliminated.

Payment was made, furthermore, only as the work was completed, and only after acceptance by the sewer superintendent. Usual procedure was for him to inspect approximately a mile of cleaned sewer at a time. Rather significantly, there wasn't one instance in which he had to ask the contractor to reclean a section of sewer line once it had been submitted for final approval.

Because of the expense saved, and the efficient and expeditious rehabiliation job performed, Aurora is convinced that it has come out ahead, by a considerable margin, through use of outside forces, instead of its own, for this work.

W. M. "Bill" Wallace Retires at Detroit

When W. M. Wallace announced that he would retire on May 10, as Supt. of Filtration and Sewage Treatment at Detroit, we asked him for some details as to his tenure of office. His reply was so interesting that we publish it here in its entirety.

"Dear Editor:"—Thank you very much for your kind letter of March 12, but I am afraid that my tenure of office here has not been of great interest. However, I will endeavor to give you a short outline.

"I came to Detroit on Feb. 1, 1914, a stranger in the City, and visited the Water Works Park plant at that time. I was employed as chemist and record clerk to look after the chlorination of the water supply which had started in 1913, using hypochlorite lime. There was no laboratory, and it was necessary to set one up in one of the towers of the old pumping station. All we had from scratch was one room.

"Before not too long, however, this was equipped with the necessary pumps, lights, water, drains and other equipment. I was the sole employee, with the exception of three chlorination operators and, in addition to testing the water, I was collector of samples, maker of media, etc. I also did some testing of cement, oils, coals, and the like. In my spare time, I was supposed to help keep the records.

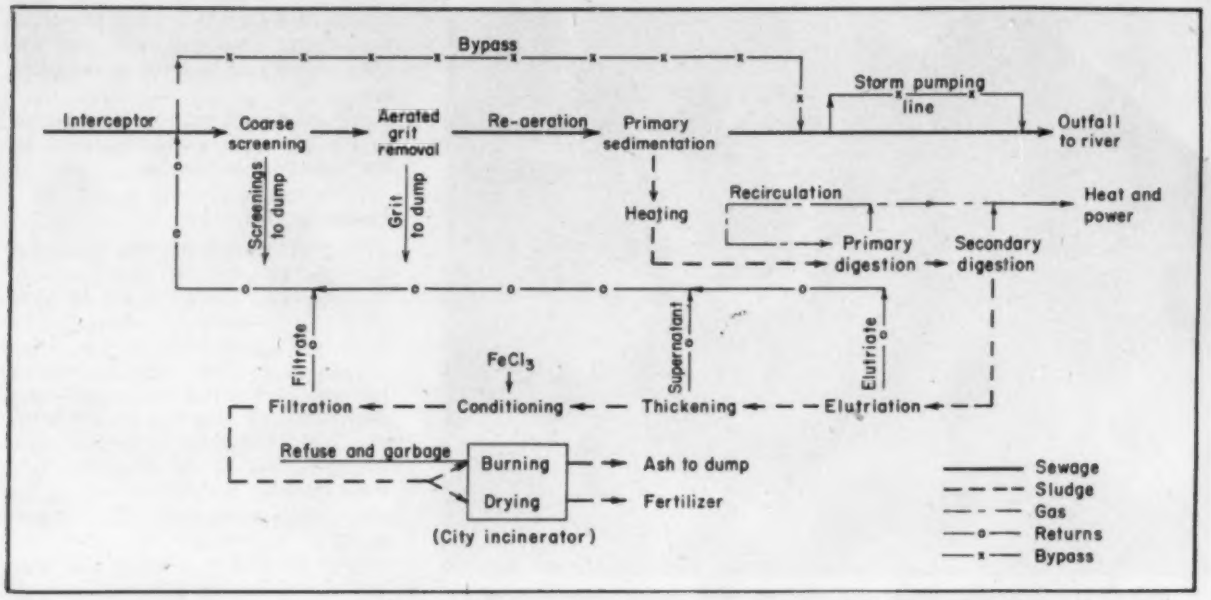
"There has been a tremendous growth in our purification activities since that time as we now operate three large filtration plants; Water Works Park, with a capacity of 320 mgd, Springwells, with a capacity of 272 mgd, and Northeast, with a capacity of 196 mgd. As you probably know, we are enlarging and renovating the Springwells plant, both filtration and pumping, at this time.

"We operate a very well equipped laboratory at each of these plants, with 24-hour laboratory control of the processes. Our staff has really grown during this time from one person to twenty-seven persons (technical personnel only).

"I have been a member of the American Water Works Association since 1922, and was past-chairman of the purification division and author and co-author of numerous articles on water purification. For your further information, if you care to use it, the City of Detroit was one of the first if not the first city, to have 24-hour laboratory control of water purification processes.

"During the year of 1940, for a short period of time during the starting up of activities of the Sewage Treatment Plant, which is operated by the Department of Water Supply, I had charge of that plant. Yours very truly, W. M. Wallace.

A friendship founded on good business relations is a deal better than a business founded on friendship.—*J. D. Rockefeller*



FLOW DIAGRAM of new Louisville sewage treatment plant.

Louisville Sewage Facilities Under Construction

Coordinated planning meets sewage, garbage, and flood control needs.

by LaRUE SPIKER
Technical Writer
Crestwood, Ky.

FULFILLMENT of an urgent need for improved sewage disposal facilities is now well on the way to realization in Louisville, Ky. Construction of a $6,000,000 primary treatment plant was begun in the spring of 1956 and will be completed by 1959. A part of the plant's operations will be coordinated with the work of a $4,600,000 garbage and trash incinerator also now under construction.

Louisville's Metropolitan Sewer District embraces one-third of Kentucky's sewered population, and outmoded methods of disposal have constituted one of the most serious sanitation problems in the state. Serious water pollution has resulted from daily discharge of some 75 mg of raw sewage from 17 outlets directly into the Ohio River. The Kentucky State Board of Health has been demanding improved methods of disposal since 1949.

The new plant and expanded sewer system result from coordinated planning and development by a number of city bodies and the federal government. Late in 1953 the proposed plan was held up by the Ohio River Valley Water Sanitation Commission as a standard for all cities on the Ohio River from Cincinnati, Ohio, to Cairo, Ill.

The plant is designed for primary treatment. It is expected to remove substantially all settleable solids and not less than 45 percent of the suspended solids. The process will adequately comply with the standards of the Commission—an intestinal bacterial count of not more than 5,000 per 100 milliliters of water.

The new plant should meet the area's disposal needs until 1977, when the population of the District will probably reach about 510,000. It is designed to handle an average daily dry weather flow of 100 mg of sewage. The present layout makes possible expansion of facilities when needed to increase the average daily dry weather flow to 150 mg.

Coordinated with Flood Work

Raw sewage will flow into the plant from an 11-ft concrete intercepting sewer which is under construction. This cross-town link will connect the plant with the District's present 688 miles of sewers by intercepting the sanitary flows from the existing 17 sewer outlets. Parts of the sewer system were laid 100 years ago. District planning has been coordinated with the U. S. Corps of Engineers for joint use of part of the federal flood interceptors and pumping stations to convey sewage to the treatment plant.

A bypass system at the plant will provide uninterrupted flow from the

SEDIMENTATION tanks under construction, with sludge Monorakes at far end behind effluent launders.

sewers directly into the Ohio River in case of heavy storms.

When the lower pool of the river reaches 410 ft above sea level, which is considerably above normal, the interceptor line into the treatment plant and the outfall line from the plant will be closed by sluice gates. This will shut off flow into the plant and prevent the river from backing up into the plant. The plant will suspend operations until the pool stage drops below elevation 410. All outlets above the plant will discharge sewage directly into the river. At this elevation the volume of flow in the river is considered sufficent to allow an adequate margin of safety against pollution.

Plant Units and Operation

During periods of normal or below normal river level, the sewage will pass from the interceptor outlet into the plant at the screen and grit building. Here heavier materials will be screened out and later hauled away for dumping. The sewage will then pass into aerated grit channels, where the heavier grit will fall to the bottom and the suspended materials flow into the sedimentation basin. Screening and grit collecting equipment has been furnished by the Link-Belt Corp. Aeration equipment was obtained from the Chicago Pump Co. Blowers for the aeration system are established in a separate building. They were furnished by the Roots-Connersville Blower Division.

The sedimentation basins have a capacity of 84 mg. The liquid is reaerated in the influent channel to obtain more oxygen for purification. After sedimentation the liquid is expected to be 35 percent free of bacteria. It is discharged into the river through an 11-ft concrete outfall sewer.

The sludge will be pulled to sludge hoppers by the Dorrco Monorake method, then be pumped to the digestion control building where it is heated before pumping into the digestion tanks.

Most of the pumps in the plant were obtained from three companies: Marlow Pumps, Fairbanks-Morse, and Chicago Pump Co.

Each of the two primary digestion tanks, has a capacity of 2 mg, providing for 10 to 15 days holding time. They are equipped with Pacific Flush Tank Co. floating covers. Digestion will be accelerated by maintaining temperature at 90° to 95° F and by pumping part of the gases generated back through the sludge with a Pearth gas recirculating system.

The sludge is then transferred to the secondary tank where it will remain for 35 to 40 days. The digested sludge then goes to the elutration tanks for washing and thickening, the latter being accomplished by a revolving paddle system furnished by Dorr-Oliver Inc.

De-watering of the digested sludge is by conditioning through addition of ferric chloride and filtering on a Komline-Sanderson coil filter. The filtrate is returned to the influent chamber to pass through the plant again, the solid matter being hauled by trucks to the city incinerator for drying or burning.

Utilizing the city garbage and trash incinerator rather than building one at the disposal plant has saved an estimated $500,000 in plant construction costs. Transport will cost less than would fuel to burn at the plant site.

All electrical controls and panels in the plant were manufactured by the General Electric Co.

Financing

Cost of constructing the plant has been met by a $6,000,000 general obligation bond issue, approved by a 4 to 1 majority in a referendum in 1953. The majority was obtained after a community-wide campaign calling for support of the proposed bond issue. Best of nine bids on the bonds was submitted by an investment syndicate headed by the First National City Bank of New York, calling for an average interest rate of 2.524 per cent.

The MSD will maintain and operate the treatment plant at an estimated cost of $350,000 annually with funds from the regular sewer service charges and any special fees which may be levied.

The $10,200,000 cost of constructing the interceptor sewer will be paid by MSD revenue bond issues and sewer service charge revenues.

MSD is financing the $777,000 cost of the sludge drying equipment and building at the city garbage and trash incinerator from the $6,000,000 general obligation bond issue previously mentioned. The district will meet unusual maintenance costs on this equipment from sewer service charges. The Raymond Flash Drying System, by Combustion Engineering Co., is being used. Conveyor equipment was obtained from Millerhoefft Inc.

Refuse Incinerator and Sludge Drying

The incinerator now under construction will cost about $4,600,000 in addition to the $777,000 for the sludge drying and handling equipment and buildings. It also was financed by a special general obligation bond issue, and will be administered by the City Sanitation Department. Although it is separately administered and financed, discussion of plans for its construction were related to the sewage disposal process.

In addition to drying and burning grates, the incinerator will utilize the rotary-kiln process, developed in Sweden about 1940 and instituted in this country in Atlanta, Ga., in 1948.

The rotary-kiln process was chosen because it burns a wider range of material in both size and type without leaving a residue. Temperature of burning materials will be kept high

enough to eliminate all odors—an important factor because the incinerator is located in the center of town. Gases will pass through a spray chamber where all fly-ash will be washed out before they enter the chimney.

The incinerator will be able to handle up to 750 tons daily. Present daily refuse dumpage is 500 tons, and to this must be added the sludge from the sewage plant. Space at the old city dump will soon be exhausted, and it will be converted into a part of the city park system.

Yearly operating costs of the incinerator are anticipated at about $200,000. About $95,000 will be saved annually in reduced haulage and by eliminating maintenance of the old dump. It is hoped that revenue from sale of cans and metal processed for scrap, and of dry sludge for fertilizer, will amount to about $135,000 a year.

FLOATING COVER during installation on one of the digestion tanks. Pearth gas recirculation system will be employed.

Fertilizer from Sludge

There was considerable public discussion prior to a decision to install sludge drying equipment for the production of fertilizer base. It was pointed out that a number of American cities have begun to realize an income from the sale of fertilizer from processed sludge. Milwaukee produces a fertilizer called Milorganite from which it realizes a profit. Revenue from sale of a similar product in Houston, Tex., totals about $200,000 yearly. It was noted that other methods of disposal would cost that city from $100,000 to $443,000 per year.

This fertilizer is used for lawns, golf courses, parks, and in some types of agriculture. It increases the capacity of the soil for holding water and also improves soil structure by allowing the entrance of air and adding important minerals.

According to a study made by the Ohio River Valley Water Sanitation Commission this type of fertilizer is safe for any reasonable use in agriculture.

Good Planning

Several important facts emerge from the planning and development of Louisville's new sewage disposal plant. It is a good example of the application of modern engineering to the sanitation needs of a growing metropolitan community. Existing sewers were incorporated into the new system, which is synchronized with flood control. Money was made available by proper planning and intensive interpretation to the public. The project involved coordinated planning and inter-locking financing by several branches of government, and costs have been reduced by coordination of operations. Partial liquidation of operating costs is expected to be accomplished through the sale of by-products.

The plant was designed by Metcalf & Eddy of Boston. This consulting engineering firm is also furnishing general and resident supervision of construction. Contract for construction of the plant was awarded the Gust Newberg Construction Co. of Chicago. Morris Forman, Engineering Consultant for the Metropolitan Sewer District is responsible for coordination of operations and approval of any changes.

What About Rebuilt Ball Bearings?*

This is a subject that has seldom been discussed in print, so far as this writer knows, and it is important. There is no good reason why an expensive ball bearing should be junked as soon as it ceases to give satisfactory service. I would like, therefore, to say a few words about rehabilitating worn bearings of this type.

I had the good fortune to be conducted through a factory not long ago —a factory that is devoted exclusively to the rebuilding of ball bearings. The experience was unusually interesting and instructive. I learned that not only can ball bearings be rebuilt but the president of the company insisted that the finished product is usually better than the original. In fact the company "guarantees" that the rebuilt bearings will give service at least equal to that of new bearings.

First, before rebuilding, they minutely inspect the old bearings. The original balls and retainers are junked. If the rings do not measure up to the S.A.E. tolerance limits they, too, are junked. Then, the remaining rings are given a scleroscopic test for hardness. This test eliminates all rings that are improperly heat treated, fire cracked, burned, or that have been over-heated due to improper lubrication.

Next, the outer rings are reground and the size of ball to be used is determined. Then the inner ring is ground to fit. A new brass retainer specially designed is used in each rebuilt bearing. A new retainer is necessary owing to the fact that larger balls are required in rebuilt bearings than in new. Lastly, the bearing is cleaned, inspected, dipped in a special hot petroleum and wrapped in waxed paper.

One of the strong arguments favoring rebuilt bearings is that carefully inspected rings that have seen actual service are preferable to new rings that have never been in service.

And finally there is the good argument that because of the larger balls used in rebuilt bearings a greater load carrying capacity is assured. This surely is a matter worth remembering when your ball bearings begin giving trouble. They can probably be advantageously rebuilt.

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

SEWAGE WORKS PRACTICES

Sludge Disposal

Series 2——Part 9

by DON E. BLOODGOOD

Mr. Bloodgood is Professor of Sanitary Engineering at Purdue University, Lafayette, Ind. In this series, he discusses SEWAGE WORKS PRACTICES in a manner designed to assist plant operators, students and others who wish to review the subject matter.

IN THE TREATMENT of sewage the main objective is the removal of the solids from the liquid portion. The removed solids—primary sludge, septic tank cleanings, activated sludge, chemically precipitated solids, humus from trickling filters, Imhoff sludge, solids from separate sludge digestion —all require further attention before the sewage can be said to be purified. In many instances the remaining solids are as much of a problem as the purification of the sewage.

The sludge that must be processed has been handled by any of the following methods, or by combinations of them:

1. Vacuum filtration.
2. Incineration.
3. Dumping at sea.
4. Drying on sand beds.
5. Lagooning.
6. Kiln drying.
7. Fertilizer production.
8. Vitamin B_{12} production.
9. Freezing.
10. Centrifuging.
11. Flotation.
12. Composting.

Vacuum Filtration

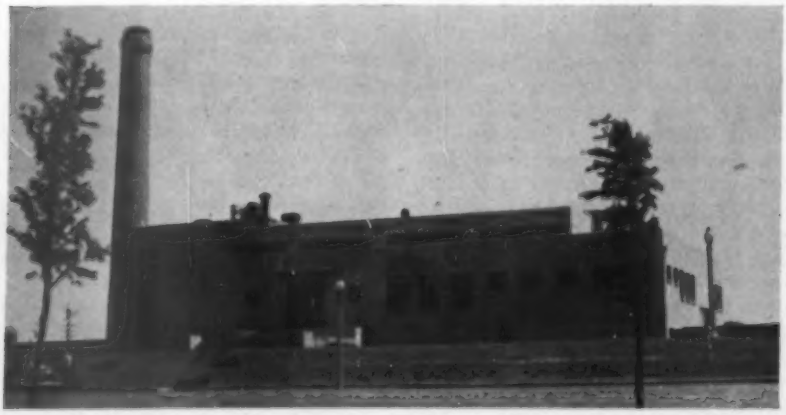
Practically all of the sludges that have been produced have been dewatered on vacuum filters. Activated sludge is being filtered at large plants such as those in Milwaukee, Wis., and Chicago, Ill. Primary sludge is filtered at Minneapolis-St. Paul, as well as in many other places. Sludges containing precipitated chemicals are filtered at East Chicago, Ind. It is safe to say that attempts have been made to filter any and all sludges.

In vacuum filtration of sludges it is necessary to add chemicals that "condition" the sludge (coagulate the solids) so that the water is more easily separated from the solid particles. The chemicals that are commonly used include ferric chloride, ferric sulphate, chlorinated copperas, alum, aluminum chloride, lime, and sulphuric acid.

Ferric chloride has been said to have two effects on the solids. It is believed that the charges on the particles are neutralized by the ferric chloride, thus making it easy for them to clump together. It also has been said that the ferric chloride has a tanning or shrinking effect on the sludge particles.

The quantity of ferric chloride used is often stated as a percentage of the dry weight of the sludge solids. It is interesting to note that it has been found that the most rapid filtration occurs at a certain pH, depending on the kind of sludge and the chemical being used. The same pH is desired even when there is a different concentration of solids in the sludge.

Center [1] has written quite extensively about the coagulant requirements of sludges being dewatered by vacuum filtration and has given some methods for calculating the quantity of chemical or chemicals required for filtering the different sludges. He says that in considering the problems encountered in filtration of sludges it is necessary to realize that water makes up a large percentage of any sludge, and that in the decomposition of sludges the organic solids are destroyed, thereby increasing the concentration of minerals in the water fraction of sludges of similar concentration that then remain. He goes on to say that there are instances where bicarbonates are known to increase being digested. Some bicarbonates are probably also trapped in the sludge almost 100-fold while the sludge is particles and as a consequence, add



VACUUM FILTRATION and incineration at East Chicago, Ind., plant are housed in modern building of functional design.

FIRST SUCCESSFUL full-scale sludge furnace was this installation at Dearborn, Mich.

to the chemical requirement for satisfactory filtration of the sludge.

The reactions that take place between the chemicals and the bicarbonates in the liquids of the sludges are probably similar to the following:

$$FeCl_3 + 3\ NH_4HCO_3 \rightleftarrows Fe(OH)_3 + 3\ NH_4Cl + 3\ CO_2 \quad (1)$$

and

$$2\ FeCl_3 + Ca(HCO_3)_2 \rightleftarrows 2\ Fe(OH)_3 + 3\ CaCl_2 + 6\ CO_2 \quad (2)$$

It can be shown from Eqs. 1 and 2 that it requires 1.08 parts of ferric chloride for every equivalent part of calcium carbonate present as alkalinity in the liquids of the sludge. Some digested sludges have been found to contain as much as 3,500 ppm of alkalinity.

Genter believes that the solids demand for coagulant depends on the percentage of solids present in the sludge and the percentage of volatile solids. He has developed formula:

$$X = 1.03\ Y_1 + 1.6\ Y_2 \quad (3)$$

in which X = the total ferric chloride dose as a percentage of the solids, Y_1 = the percentage of sludge water × ppm. alkalinity × 0.0001 divided by percentage of sludge solids, and Y_2 = the ratio of volatile to ash in a sludge.

In an example where the alkalinity is 260 ppm, solids 9.35 percent, water 90.65 percent, volatile 62.1 percent, and the ash 37.9 percent, the calculated requirement would be 2.89 percent. From this example it can be seen that about 10 percent of the coagulant is required for the reaction with the alkalinity. Genter and others have shown that by removing the alkalinity with a process of washing called "elutriation" it is possible to reduce materially the chemical requirement in filtering sewage sludges.

The filtering medium on vacuum filters has been one of the problems that has perplexed operators in the past and efforts are still being made to find filtering media having long life and capable of being operated for long periods without washing. Cottons, wools, and the new synthetic fibers have all been used. Each filter operator has his own opinion as to which material gives the most economical operation in his plant.

The coil spring filter uses no cloth and there is no danger of the filter medium rotting during shutdown periods.

Kirkland, Wash., filters digested sludge at a cost of $6.25 per cubic yard of filter cake for chemicals, labor, and maintenance. The sludge sells for $3 to $5 per cubic yard.

The sludge from vacuum filtration may be placed as fill, or dried and used as fertilizer, or incinerated and the ash discharged as fill.

Incineration

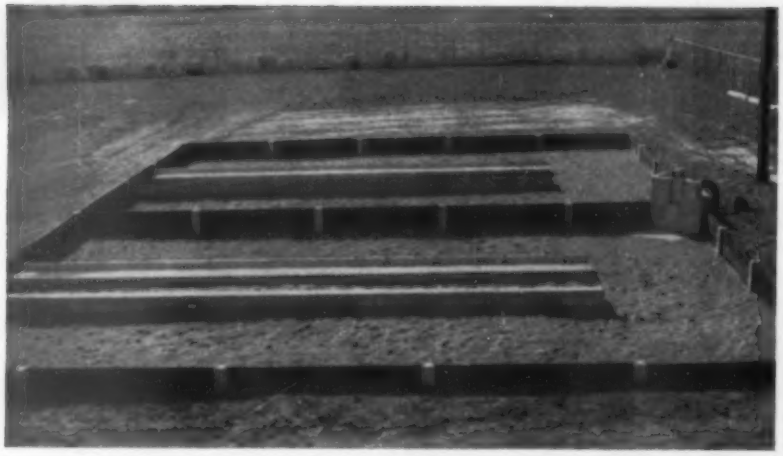
Sludges from all processes have been incinerated. For successful operation it is necessary to dewater the sludges to some extent before burning is attempted. The more common practice is to vacuum filter sludge before incineration, but there is no reason why sludges dried on sand beds or in lagoons cannot be incinerated.

Owen [2] has said that the best way to determine the quality of the sludge for incineration is to know the ultimate analysis, but even this is not exact information. Average data on the ultimate analysis of various waste materials are given in Table 1, taken from Owen's paper. He points out that the sludge analysis will vary because of the different concentrations of grease that may be found in sewage sludges; some have shown as high as 13,900 Btu per pound, and

TABLE 1

Ultimate Analysis of Waste Materials

Material	Carbon	Hydrogen	Oxygen	Nitrogen	Btu/lb
Wood	53.5	6.0	40.4	0.1	9,900
Garbage	54.5	7.5	35.0	1.0	10,000
Rubbish	53.0	6.0	37.5	3.5	9,000
Sludge	55.0	7.0	35.0	3.0	10,000



NEW OPEN, DRYING BEDS at Whiteland, Ind., use plank step-log sides and provide easy loading by elevated concrete truck runways.

some raw sludges have been found to contain 75 percent combustible matter, although digested sludges may contain only 50 percent combustible matter.

The vertical multiple-hearth furnace has been used extensively in the disposal of sewage sludges. In these furnaces the wet sludge cake is injected on the top hearth and dries as it passes from the top hearth down. On the lower hearth combustion takes place and the heat released dries incoming sludge. The ash is collected at the bottom and can be transported by air, water, or vehicle to the dumping ground.

In the incinerator the moisture admitted with the sludge must be raised to 212°F, changed into steam, then raised to the combustion temperature in the furnace or to the final gas outlet temperature. The ash must be raised to the final exit temperature. A sufficient amount of air must be admitted to oxidize all of the combustible matter present. The combustible matter must be raised to the ignition point and all of the products of combustion must be raised to the gas outlet temperature.

The heat losses in an incinerator must be made up by energy from some source. The heat losses commonly considered include heat radiated through the furnace walls, heat used in raising the temperature of excess air, heat lost in ash discharge, and heat lost in air or water used in cooling certain parts of the furnace.

The heat available from a particular sludge can be estimated if analysis of the material to be burned is available; however, it can be noted from Table 2 [3] that there is considerable variation in the calorific values of sludges, so the calculated heat value may be considerably in error.

In some places the sludge is only dried and the solids are then removed and sold as fertilizer. In such instances all of the heat required for the drying must come from coal, oil or gas supplied from outside sources.

TABLE 2

Calorific Value of Sludges

	Type of Sludge	Btu/lb. Dry Solids	Btu/lb. Combustible Solids
A	Digested	5,975	12,480
B	Digested	5,830	10,750
C	Digested	5,290	8,980
D	Digested	4,980	9,500
E	Fresh	9,485	13,855
F	Fresh	10,285	13,905
G	Fresh	9,125	11,415
H	Fresh	7,010	10,155

Freezing

Freezing of sludge to facilitate dewatering has not been practiced in the United States. Many a sewage plant operator has observed that frozen sludge dewaters very quickly and the solids after thawing make excellent humus, having lost the sticky characteristic of partially dried sludge.

It has been speculated that the freezing action breaks the cell walls that retain the internal moisture in sludge. It is believed that if sludge could be frozen and thawed without the loss of any great amount of energy the process would be used extensively for preparing sludge for disposal. Clements *et al.* [4] have experimented with freezing and they believe that complete freezing with chemicals can be used successfully if power costs can be kept very low. At the present time freezing can be taken advantage of only as it can be utilized in nature. Sludge that has been frozen on a drying bed will be a better material for use as a fertilizer when it thaws. Sludge that freezes in a shallow lagoon will dewater readily when thawed, providing it is possible for the water to drain away from the solids.

Liquid Sludge Disposal

One of the most troublesome problems in the disposal of sludges has been the separation of the liquid and the solids. Some of the complaints about processes used for separating the water and solids have been that filtration is expensive and that drying beds are unpredictable because of weather conditions. Whether these complaints are just, one cannot positively conclude because of many variables. It can be said with safety, however, that if sludge could be disposed of without separating the solids from the liquid and without any effort or expense there would be great rejoicing.

Sludges contain so much water that liquid sludge disposal requires the handling of excessive quantities of water.

The quantity of solids that can be removed in a 1,000-gallon tank truck amounts to only about 800 pounds, while the 1,000 gallons weighs about 4 tons. The manpower required in handling the liquid is, of course, very much less than that required in the handling of 800 pounds of solids. Ross [5] has reported that it takes about one-twelfth the time to load liquid sludge that it does to load drying bed sludge. If the 800 pounds of solids are in sludge from a drying bed they would weigh about 1 ton and would occupy a volume of about 1 cubic yard.

Liquid sludge is hauled to sea for dumping in some instances. This makes a satisfactory way of disposal in those places where it is possible to have water shipping facilities. The cost of disposal is not reported as being unusually low. New York City has practiced this method of disposal for many years.

When liquid sludge disposal by truck is practiced it is not possible to operate the facility during all seasons because it is not possible to haul onto farm land during wet weather. In those cases where ample storage space is provided in digestion tanks this is not a serious problem. In some instances lagoons are provided and sludge is discharged to them during the time that trucking cannot be done.

Liquid sludge must be digested because of the possible nuisances that would arise if primary or activated sludges were to be discharged on the land.

Backmeyer [6] discontinued the use of vacuum filtration at Marion, Ind., and this city has practiced liquid sludge disposal since 1943 with apparent success. The cost of liquid sludge disposal was reported to be 77 percent of the cost of vacuum filtration with no accounting for the costs for equipment being used.

Drying Beds

Drying beds are a very common method for the disposal of digested sewage sludge. A few attempts have been made to add other sludges to drying beds, but they have not been successful.

At Fort Wayne, Ind. [7], it has been the practice to make more than one application to a bed before the sludge cake is removed. This is not a conventional procedure and it is surprising that it is reported to give greater bed utilization.

The Fort Wayne open drying beds are not cleaned between the first of December and the middle of March. This necessitates a sludge digestion tank storage capacity large enough to hold a 3½-month accumulation unless sludge lagoons are utilized during the winter period.

During the months when the beds are being cleaned it takes two to five days to remove the sludge from one bed that contains 19,555 square feet.

Covered drying beds are advantageous where rain interferes with the drying or cleaning. The effect of rain has not been definitely determined because it seems to depend on the state of dryness of the sludge at the time of the precipitation. If the sludge has dried to the point of cracking, the rain does not seem to delay materially the removal of the sludge.

Sludge that does not crack shows evidence of incomplete digestion and such sludge will not dry in any reasonable time.

Richmond, Ind., reports that the shortest time between loading and removing the sludge from a drying bed has been ten days.

At Dayton, Ohio [8], the drying rate for glass covered beds is 17 pounds of dry solids per square foot per year, whereas on open beds the loading was 16 pounds.

Sludge when removed from drying beds should contain about 70 percent moisture if it is to be used for fill or fertilizer.

Fertilizer Production

Activated sludge and digested sludges of all kinds have been dried and sold as fertilizer. The organic material, plus the nitrogen, phosphoric acid, and potash, in the sewage sludge make it a desirable soil builder. The plant food materials present are not in sufficient quantity to make the dried sludge valuable from that standpoint. It is believed that digested sludge is somewhat comparable to farm manure in its content of fertilizer materials. Milorganite, the product made in Milwaukee from activated sludge, contains about 6.0 percent of nitrogen, 3.4 percent phosphoric acid, and 0.65 percent potash.

To produce fertilizer the cake from vacuum filtration is dried in either rotary or flash drying equipment. The filter cake may contain 75 to 85 percent moisture and sludge cake containing more than 50 percent moisture has a tendency to form in balls in a drier. Therefore, it is necessary to mix previously dried solids with the filter cake to bring the moisture content of the material to be dried below the 50 percent figure previously mentioned.

Kiln dried sludges are heated to temperatures that preclude possibilities of pathogenic bacteria or intestinal parasites being carried by the sludge [9].

At Milwaukee the dried sludge is being processed to recover vitamin B_{12}. Extraction of the vitamin does not adversely affect the value of the sludge as a fertilizer and soil builder.

COVERED DRYING BEDS, such as these at Franklin, Ind., reduce weather problem in sludge drying.

Composting

Many attempts have been made to compost sewage sludge with other organic materials. It cannot be said that composting cannot be accomplished, even though it is not done extensively. The composting or decomposition takes place in a satisfactory manner when the right conditions are maintained. To date, the speed with which the composting takes place is slow, requiring retention of the materials for longer than seems feasible. There is considerable labor involved in the operation of the process because it has been necessary to turn or mix the materials periodically as the decomposition progresses.

The material remaining after composting is much like the leaf mold found in the woods. It is quite satisfactory for mulching trees and shrubs, but it is not necessarily free of pathogenic organisms unless it is heat dried prior to marketing.

Pumping to Sea

Pumping of waste sludge to sea perhaps should be considered as a method of liquid sludge disposal, except that the sludge is not hauled. The pumping of sludge to sea can be practiced only on the seacoast and then only where the conditions are such that there is no danger of contaminating the beaches in the vicinity of the discharge. It is the usual custom to digest the sewage sludge prior to discharge. The period of digestion accounts for a considerable decrease in the pathogenic bacteria found in the raw sludge. The digestion decreases the organics that will decompose at the point of discharge and, of course, in the decomposition prior to discharge considerable combustible gas is recovered.

The process of disposal at sea is not without potential dangers; therefore, it is necessary to make a very thorough study whenever it is considered as a method of disposal.

Summary

The problem of sludge disposal is as great or greater than that of purifying the sewage. There is no one way that seems better than all others for the disposal of sewage sludge.

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Henry Wilkens Joins Freese, Nichols & Turner

Henry Wilkens, Jr., Dist. Mgr., of the Texas Water Co., in Houston, Texas, has resigned that position to join the consulting firm of Freese, Nichols and Turner. Mr. Wilkens'

duties will fall in the area of municipal engineering and he will devote his efforts to contact and public relations work with clients and prospective clients.

A native of Galveston, and a graduate mechanical engineer from Rice Institute, Mr. Wilkens has had a varied experience including general machine shop work, superintendent of the Galveston Water, Sewage and Street Lighting Dept., District Manager of the Texas Water Co. for 7 years and Manager Harris County WC & ID No. 58.

Mr. Wilkens has been active in AWWA and FSIWA and has served as Chairman of the Southwest Section of AWWA, as well as a member of many committees of this section and other water and sewage associations in the Southwest. He is known to readers of *Water & Sewage Works* as a contributor of "Dear Bill" letters under the pen name "Hank".

Symposium on pH Measurement

To keep pace with significant developments in the field of pH measurement the Amer. Soc. of Test. Materials organized a symposium on the subject. This is the second such symposium, the first was ten years ago. This second symposium was published and sponsored by the ASTM Committee E-1 on Methods of Testing. The 101 page book contains seven full length articles of value to the theorist, analytical and physical chemist as well as to the practicing process and control engineer. Copies of the book may be obtained from the Amer. Soc. Test. Mtls., 1916 Race St., Philadelphia, Pa., at $2.50 each.

John J. Mathison Heads San. Engrg. Div. of Green Engrg. Co.

The Green Engineering Co., of Pittsburgh, Baltimore and Boston has announced that John J. Mathison has been appointed head of the Sanitary Engineering Division of the company. Mr. Mathison, a graduate of Carnegie Institute, will be in charge of all problems in connection with water works, drainage, industrial wastes and sewage treatment. He was formerly associated with Morris-Knowles, Inc. of Pittsburgh.

Water Pollution Control For Hawaii, Puerto Rico and Virgin Islands

The Public Health Servcie has released plans covering the water pollution control needs for Hawaii, Puerto Rico and the Virgin Islands. A report on Alaskan needs will be announced later

The plans were prepared by engineers of the Service's Water Supply and Water Pollution Control Program in cooperation with the Islands' health departments.

The reports indicate that water pollution control needs for Hawaii include additions to existing plants, or new plants and sewer systems in 18 districts of the Islands.

The Puerto Rico report named 75 cities and towns needing additions, replacements or new sewage treatment plants.

In the Virgin Islands the report showed a need for six new plants.

Under the Water Pollution Control Act, Hawaii has been allocated $496,100, Puerto Rico, $1,185,000, and the Virgin Islands, $830,000 for construction of waste treatment works during the current fiscal Year.

Editorial Associate of Water & Sewage Works to Receive AWWA Award

Mr. John R. Baylis, long-time Engineer of Water Purification for the City of Chicago was voted the AWWA. Purification Division

Award for the best water purification paper published in the 1956 Journal. The title of the paper was "Seven Years of High Rate Filtration." It will be reprinted in the 1957 Reference and Data Number of *Water & Sewage Works.*

Mr. Baylis is a graduate of Mississippi State College with an outstanding record in the water purification field. He is the inventor of a turbidimeter, butterfly valve insert, surface wash system, and activated silica and split-treatment process for water treatment. He is an authority on taste and odor control, corrosion, coagulation and high rate filtration. Mr. Baylis has been an editorial associate of *Water & Sewage Works* since 1930 and has written many articles for this magazine.

Proceedings of 4th Southern Municipal and Industrial Waste Conference

The Fourth Southern Municipal and Industrial Waste Conference Proceedings are now available for distribution. Copies are being sent to all registrants and to those from whom orders have been received.

Copies are available at $1.50 each, and requests should be addressed to J. W. Williams, Department of Civil Engineering, Duke University, Durham, North Carolina.

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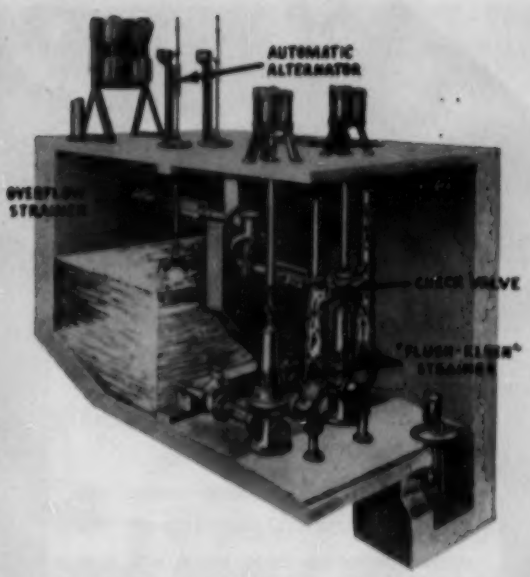

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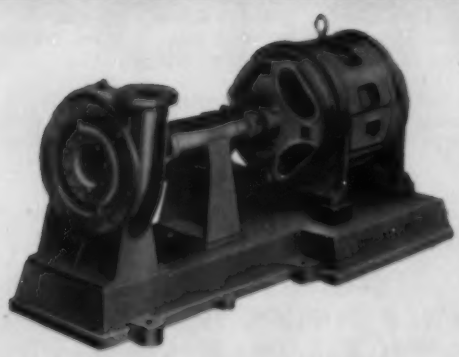

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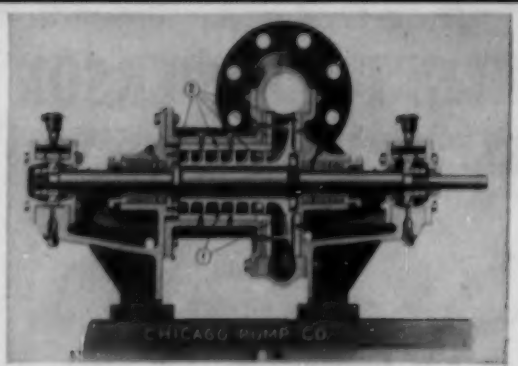

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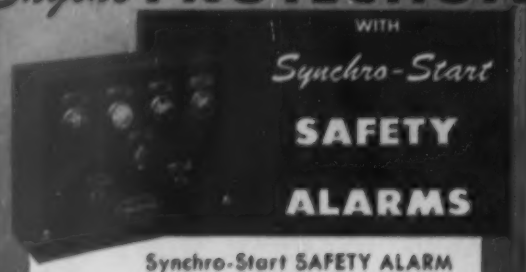

Synchro-Start SAFETY ALARM SETS automatically warn with visual and audible signals as soon as such conditions as low oil pressure, low air pressure and overheating, etc. occur.

Three switches are provided—control "on-off"—test—audible alarm cut-off. For added protection these alarm sets may be equipped with automatic shut-down in case signals are not heeded.

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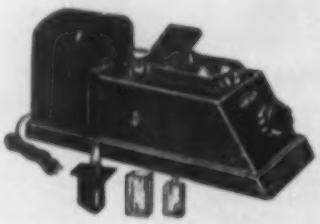
KLETT SUMMERSON ELECTRIC PHOTOMETER

Adaptable for Use in Water Analysis



Can be used for any determination in which color turbidity can be developed in proportion to substance to be determined.

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Meetings Scheduled

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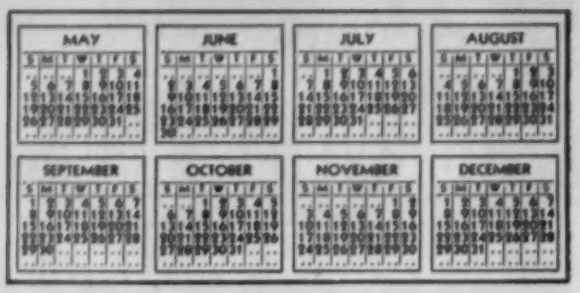


May 12-17—Atlantic City, N. J. (*Convention Hall*)
A.W.W.A. Convention, Secy., Harry E. Jordan, A.W.W.A. Assn., 2 Park Ave., New York 16, N. Y.

May 13-15—Lafayette, Ind. (*Purdue University*)
12th Purdue Industrial Waste Conference, Chairman, Prof. Don. E. Bloodgood, C. E. Bldg., Purdue University, Lafayette, Indiana

May 16—Portsmouth, N. H. (*Hotel Wentworth-by-the-Sea*)
New England Water Works Assn., Secy., Joseph C. Knox, 73 Tremont St., Boston, Mass.

May 22-24—Ocean City, Md. (*Commander Hotel*)
Maryland-Delaware Water & Sewage Assn., Secy., W. M. Bingley, 2411 N. Charles St., Baltimore 18, Md.

June 3-5—University, Ala. (*University of Alabama*)
Alabama Water & Sewage Assn., Secy., Prof. R. T. Tindall, Alabama Water & Sewage Assn., P. O. Box 1224, University, Ala.

June 3-7—Buffalo, N. Y. (*Hotel Statler*)
American Society of Civil Engineers, Exec. Secy., W. H. Wisely, 33 W. 39th Street, New York 18, N. Y.

June 6—Newport, R. I. (*Viking Hotel*)
New England Sewage & Industrial Wastes Assn., Secy., Earl R. Howard, 115 Broad Street, Hartford, Conn.

June 6—Summit, N. J. (*Canoe Brook Country Club*)
New Jersey Section, A.W.W.A., Luncheon and Summer Outing with Plant Inspection at Millburn, N. J., Secy., Albert F. Pleibel, 683 Prospect Street, Maplewood, N. J.

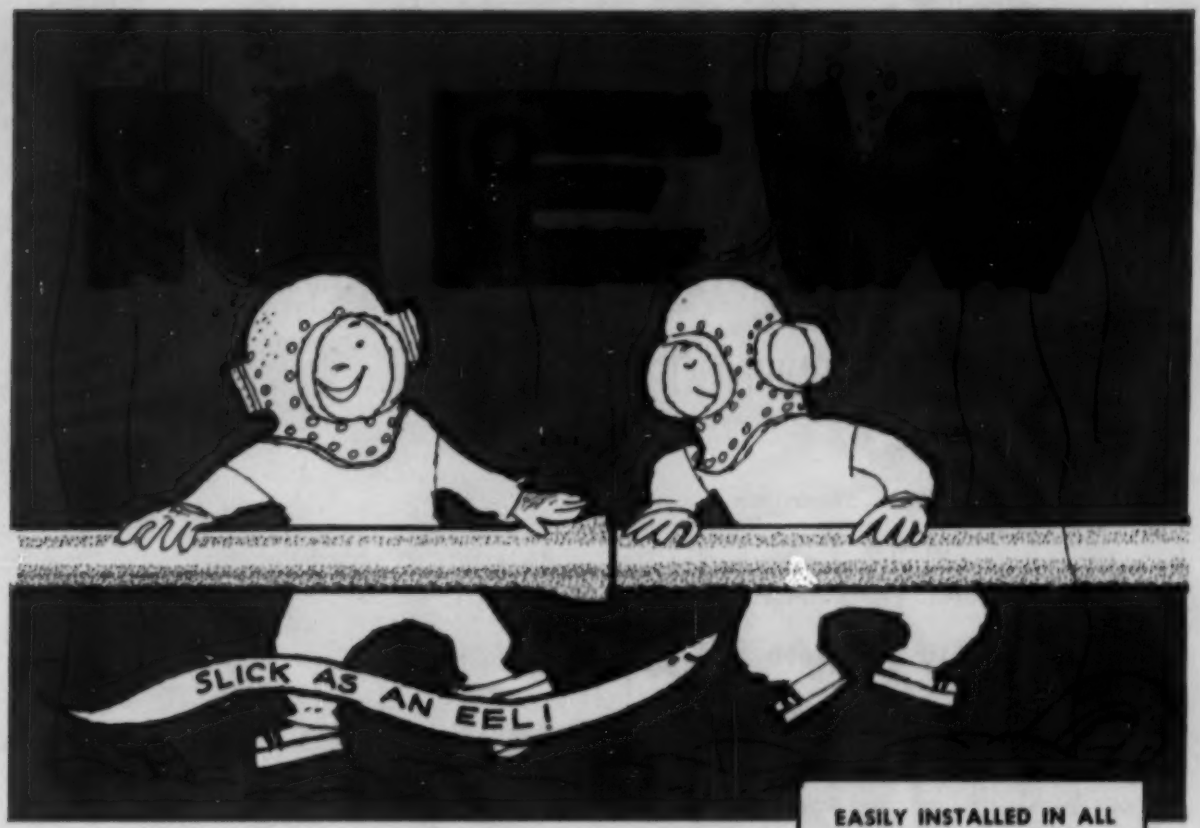
June 12-14—Bedford Springs, Pa. (*Bedford Springs Hotel*)
Pennsylvania Section, A.W.W.A., Secy., L. S. Morgan, Div. Engr., State Dept. of Health, Greensburg, Pa.

June 13—York Harbor, Maine (*Marshall House*)
New England Water Works Assn., Secy., Joseph C. Knox, 73 Tremont St., Boston, Mass.

June 17-18—Lake Placid, N. Y. (*Whiteface Inn*)
N. Y. Sewage & Industrial Wastes Assn., Secy., Ralph C. Sweeney, c/o State Dept. of Health, 21 North Broadway, White Plains, N. Y.

June 17-19—Winnipeg, Canada (*Royal Alexandra Hotel*)
Canadian Section, A.W.W.A., Secy., A. E. Berry, 72 Grenville St., Toronto, Ontario, Canada

June 19-21—Dayton, Ohio (*Hotel Miami*)
Ohio Sewage & Industrial Wastes Treatment Conference, Secy., Ward E. Conrad, 301 Ohio Departments Bldg., Columbus 15, Ohio



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Saves you so much time you'll think the clock is paralyzed. Yet assembly is simple and easy, and you get a seal that's tight as a drum. Best of all, you get Clow Cast Iron Pipe . . . for the watermain installation that is economical and permanent.

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June 19-21—Des Moines, Iowa (*Hotel Kirkwood*)
IOWA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., L. F. Skorczeski, 207 S. 15th Avenue, Marshalltown, Iowa

June 20—Castine, Maine (*Maine Maritime Academy*)
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

June 24-28—University Park, Pa. (*Pennsylvania State Univ.*)
SEVENTH ANNUAL PENNSYLVANIA SEWAGE WORKS SCHOOL, Clifford V. Smith, Jr., Dept. of Civil Engrg., The Pennsylvania State University, University Park, Pa.

June 26-28—Chicago, Ill. (*Sherman Hotel*)
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Geo. F. Bernauer, 713 Chapman St., Madison 5, Wis.

July 8-12—University Park, Pa. (*Pennsylvania State Univ.*)
SEVENTH ANNUAL PENNSYLVANIA WATER WORKS SCHOOL, Clifford V. Smith, Jr., Dept. of Civil Engrg., The Pennsylvania State University, University Park, Pa.

Aug. 8—Greenville, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Aug. 12-16—Blacksburg, Va. (*Va. Polytechnic Institute*)
VIRGINIA SHORT SCHOOL FOR OPERATORS WATER & SEWAGE TREATMENT PLANTS, W. A. Parsons, Assoc. Prof. San. Engr., Va. Polytechnic Institute, Blacksburg, Va.

Aug. 26-28—University Park, Pa. (*Penna. University*)
PENNSYLVANIA WATER WORKS OPERATORS ASSN., Secy., Harry A. DeWire, State Dept. of Health, 29 Chestnut St., Lewistown, Pa.

Aug. 28-30—University Park, Pa. (*Penna. University*)
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., J. R. Harvey, c/o Pennsylvania Dept. of Health, 916 Diamond, Meadville, Pa.

Sept. 4-6—Milwaukee, Wis. (*Hotel Schroeder*)
WISCONSIN SECTION, A.W.W.A., Secy., Harry Breimeister, Chief Utility Engr., City Engineer's Office, City Hall, Milwaukee 2, Wis.

Sept. 11-13—Upper Saranac Lake, (*Saranac Inn*)
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, Rensselaer Valve Co., c/o Ludlow Valve Co., 11 W. 42nd St., New York, N. Y.

Sept. 11-13—Sioux Falls, S. D. (*Sheraton-Cataract Hotel*)
23RD ANNUAL SOUTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Secy., Charles E. Carl, S. D. Water & Sewage Works Conference, Pierre, S. D.

Sept. 15-18—Boston, Mass. (*Hotel Statler*)
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, N.E.W.W.A., 73 Tremont St., Boston 8, Mass.

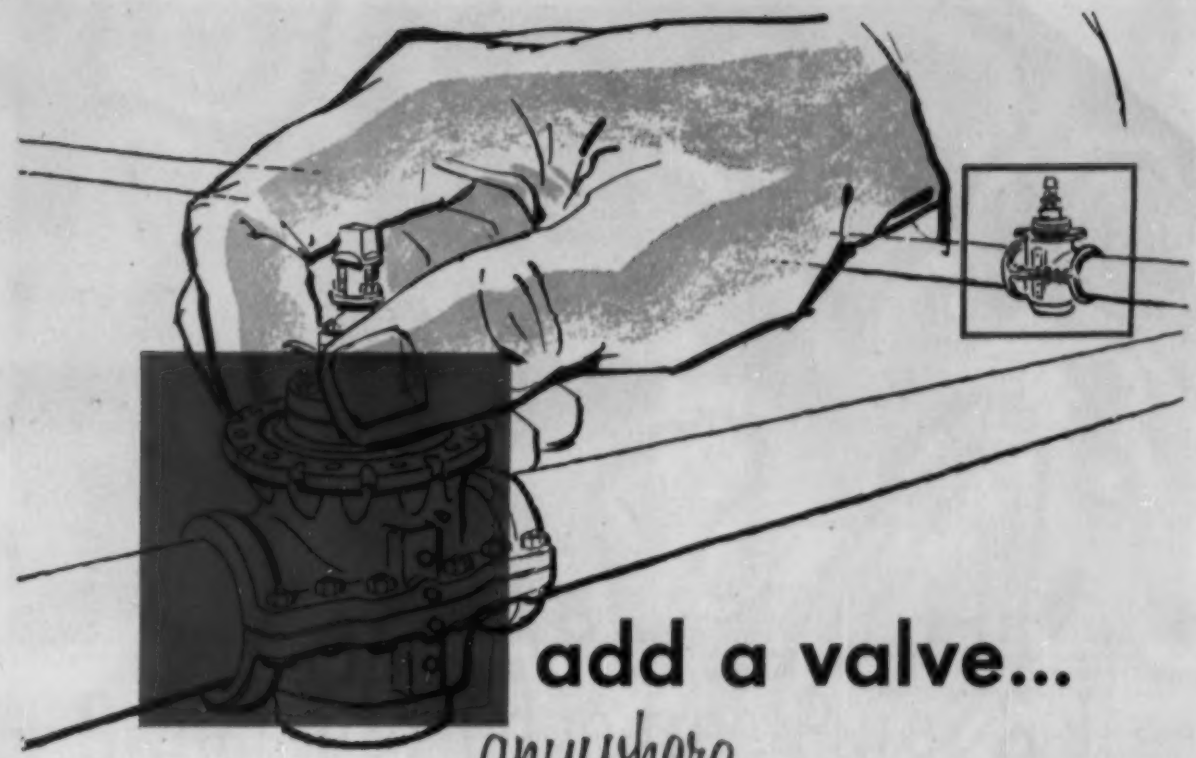
Sept. 18-20—Cincinnati, Ohio (*Netherland Plaza Hotel*)
OHIO SECTION, A.W.W.A. Secy., M. E. Druley, Dist. Mgr., Dayton Power & Light Co., Wilmington, Ohio

Sept. 23-25—Louisville, Ky. (*Brown Hotel*)
KENTUCKY-TENNESSEE SECTION, A.W.W.A., Secy., J. Wiley Finney, Jr., Howard K. Bell, Cons. Engrs., 553 S. Limestone Street, Lexington, Ky.
(*Jointly With*)
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSN., Secy., S. Leary Jones, Cordell Hull Bldg., Nashville, Tenn.

Sept. 24-25—Santa Fe, N. M. (*La Fonda Hotel*)
ROCKY MOUNTAIN SECTION, A.W.W.A., Secy., Jack W. Davis, Dist. Mgr., Transite Pipe, Johns Manville Sales Corp., 301 Continental Oil Bldg., Denver 2, Colo.

Sept. 25-26—Stillwater, Okla. (*Oklahoma A & M College*)
OKLAHOMA INDUSTRIAL WASTES CONFERENCE, Prof. Quintin B. Graves, Oklahoma A & M College, Stillwater, Okla.

Sept. 25-27—Detroit, Mich. (*Leland Hotel*)
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Velde, Chief, Sec. of Water Supply, State Dept. of Health, Lansing 4, Mich.



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Sept. 25-27—Fargo, N. D. (*Gardner Hotel*)
North Central Section, A.W.W.A., Secy., Leonard N. Thompson, General Manager, Water Dept., St. Paul 2, Minn.

(*Jointly With*)

North Dakota Water & Sewage Works Conference, Secy., Jerome H. Svore, c/o State Dept. of Health, Bismarck, N. D.

Sept. 29-Oct. 1—St. Louis, Mo. (*Hotel Sheraton Jefferson*)
Missouri Section, A.W.W.A. and Missouri Water & Sewage Conference, Joint Meeting, Secy., Warren Kramer c/o State Office Bldg., 6th Floor, Jefferson City, Mo.

Oct. 7-10—Boston, Mass. (*Hotel Statler*)
Federation of Sewage & Industrial Wastes Assns., Ralph E. Fuhrman, Exec. Secy., 4435 Wisconsin Ave., N. W., Washington 16, D. C.

Oct. 10—South Paris, Maine
Maine Water Utilities Assn., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Oct. 13—16—Oklahoma City, Okla. (*Municipal Auditorium*)
Southwest Section, A.W.W.A., Secy., Leslie A. Jackson, Municipal Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 14-18—New York, N. Y. (*Hotel Statler*)
American Society of Civil Engineers, Exec. Secy., W. H. Wisley, 33 W. 39th Street, New York 18, N. Y.

Oct. 16-18—Des Moines, Iowa (*Fort Des Moines Hotel*)
Iowa Section, A.W.W.A., Secy. J. J. Hail, Supt., Water Dept., City Hall, Dubuque, Iowa

Oct. 20-23—Biloxi, Miss. (*Buena Vista Hotel*)
Alabama-Mississippi Section, A.W.W.A., Secy., C. M. Mathews, Asst. Supt., Public Service Comm., 19 West Commercial Street, Yazoo City, Miss.

Oct. 23-24—Wheeling, W. Va. (*McLure Hotel*)
West Virginia Section, A.W.W.A., Secy., Hugh W. Hetzer, Engr., West Va. Water Service Co., P. O. Box 1906, Charleston 27, W. Va.

(*Jointly With*)

West Virginia Sewage & Industrial Assn., Secy., G. O. Fortney, c/o State Dept. of Health, Charleston 5, W. Va.

Oct. 24-26—Atlantic City, N. J. (*Hotel Madison*)
New Jersey Section, A.W.W.A., Secy., Albert F. Pleibel, 683 Prospect Street, Maplewood, N. J.

Oct. 24-26—Seattle, Wash. (*Franklin Hotel*)
Pacific Northwest Sewage & Industrial Wastes Assn., Secy., Gilbert H. Dunstan, State College of Washington, P. O. Box 176, Pullman, Wash.

Oct. 28-30—Toronto, Ontario (*King Edward Hotel*)
Canadian Institute on Sewage & Sanitation, Secy., Dr. A. E. Berry, Administrative Office, 72 Grenville St., Toronto, Ontario, Canada

Oct. 29—Nov. 1—San Jose, Calif. (*Civic Auditorium*)
California Section, A.W.W.A., Secy., Henry J. Ongerth, Bureau of San. Engr., 905 Contra Ave., Berkeley 7, Calif.

Oct. 30-Nov.1—Washington, D. C. (*Sheraton-Park Hotel*)
Chesapeake Section, A.W.W.A., Secy., Carl J. Lauter, 6955—33rd St., N.W., Washington 15, D. C.

Nov. 6-8—Roanoke, Va. (*Hotel Roanoke*)
Virginia Section, A.W.W.A., Secy. J. P. Kavanagh, District Manager, Wallace & Tiernan, Inc., 213 Carlton Terrace Bldg., Roanoke, Va.

Nov. 7-8—Hastings, Neb. (*Clark Hotel*)
Nebraska Sewage & Industrial Wastes Assn., Secy., V. J. Lechtenberg, 614 Standard Oil Bldg., Omaha, Neb.

Nov. 10-13—Jacksonville, Fla. (*Roosevelt Hotel*)
Florida Section, A.W.W.A., Secy., Jay D. Roth, Mgr. Water Department, City Hall, Miami Beach 39, Fla.

Nov. 11-13—Raleigh, N. C. (*Hotel Sir Walter*)
North Carolina Section, A.W.W.A., and North Carolina Sewage & Industrial Wastes Assn., Joint Meeting, Secy. Wilbur E. Long, Jr., 1615 Bickett Blvd., Raleigh, N. C.

Still using 2 men on this sewer-cleaning job?

The helper that was needed on this job to dump the bucket, is now released to handle other sewer maintenance problems. The Sewer Department has literally gained another man *at no extra cost.*

It's the new Automatic Bucket Dumper that does the trick. In 30 minutes, for less than 2 weeks wages, it can be installed on all existing "Flexible" Bucket Machines. And, of course, before any new Bucket Machines are purchased, you should get the full *Automatic Bucket Dumper* story.

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To learn more about this latest in a long line of "Flexible" firsts, write for the name of your nearest distributor.

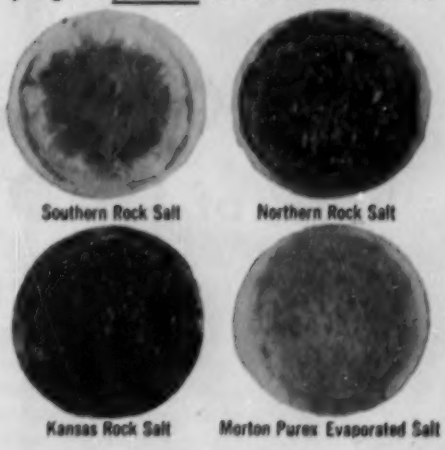
Switch to sludge-free Purex Salt

In every 100 lbs. of rock salt you buy you assume the risk of paying for up to 5 lbs. of insolubles or sludge—shale and sulphates. This means that in a 50-ton carload of rock salt you may pay for as much as 5,000 lbs. of sludge! This insoluble matter is included in the purchase price of the rock salt and accounts for part of your freight bill. It also necessitates periodic cleaning out of your brine making system.

But when you buy Morton Purex Salt, you get high-purity evaporated salt that is made in a controlled particle size to prevent packing and channeling. With Purex, none of your purchase price or freight bill goes toward paying for insolubles or sludge.

With Purex, no time or labor is wasted in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex Salt will leave no accumulation of material in either the brine or water softener tanks. It can be used in bulk wet storage systems and in the Morton Model E Brinemaker.

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.



Southern Rock Salt | Northern Rock Salt

Kansas Rock Salt | Morton Purex Evaporated Salt

Tests for insolubles taken from these random samples show you that Morton Purex is the only one that contains no wasteful sludge, or insolubles.

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W & SW

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OVERFLOW FROM THE MAIN SECTION

Pickups

From Purdue's "Sanitary Engineering News"
Don E. Bloodgood, Editor

"Since the cost of maintenance of greenhouse structures becomes progressively more expensive, it seems inevitable that these will have to be abandoned." From the Toledo, Ohio, 1953 Annual Report.

* * *

The failures of the anaerobic composting processes when tried in this country, and success of some of the aerobic processes started in the U. S., make it evident that the development of composting here will depend upon aerobic decomposition of organic refuse.

* * *

The rate of water use continues to increase. From 1945 to 1950 it rose approximately 10 per cent to reach the 140-gpcd level.

* * *

ACS Miami Meeting Water, Sewage & Sanitation Div.

A symposium on Disinfection and Sanitization with Iodine highlighted the Div. of Water Sewage and Sanitation meeting as part of the Amer. Chem. Soc. convention in Miami April 7-11. Another session covered a variety of subjects including; The removal of radio nuclides from water by polyelectroltic coagulation of shale slurries; Composting of organic wastes; The C.O.D. of citrus wastes; Activated silica; Anaerobic fermentation; Bacterial oxidation of nitrite; Chemical plankton relationships in surface waters; and Characteristics of organic contaminants of ground waters.

Sewage Treatment Plant Design Conference

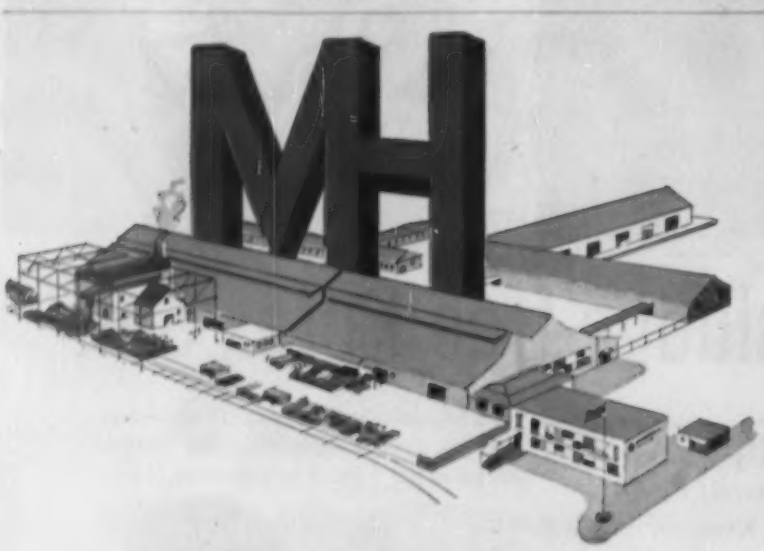
Forty-six engineers attended the recent Great Plains Sewage Treatment Plant Design Conference at Castle Hotel, Omaha, Neb.

Featured at the meeting were three papers:

Mr. Paul Bolton, Assistant Regional Engineer, Public Health Service, presented a paper on THE FEDERAL WATER POLLUTION CONTROL PROGRAM. His paper discussed Public Law 660 as it pertains to the consulting engineer. He pointed out the design features which his office critically examines when plans and specifications are submitted for U. S. Public Health Service approval.

SLUDGE DIGESTION AND SLUDGE HANDLING, was the title of a paper presented by Philip F. Morgan, Professor of Sanitary Engineering, State University of Iowa. He discussed the biochemistry of digestion and showed how it entered into design criteria.

The last paper, RAW SEWAGE LAGOONS IN THE MIDWEST, by Dr. Joe K. Neel, Biologist, U. S. Public Health Service, reviewed the biological principles of sewage lagoons. He stated that to date no simple easy method for the design of sewage lagoons existed, and that studies now are underway in Missouri to obtain more accurate design data for sewage lagoons.



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"Service" always has been a watchword in the M & H organization — service to the customer.

M & H service begins in the versatile M & H engineering department, with research and design of M & H valves, hydrants and other products. Then follows service by trained manufacturing personnel — craftsmen using highest quality materials. Add a modern, well equipped manufacturing plant, an efficient cost control system and wide-awake sales and shipping departments and you have a composite factor of service which means fulfillment of delivery schedules with superior quality M & H products.

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M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF W WALWORTH

...for treating domestic and industrial wastes

18-month test shows HI-CONE system operating costs are 44% less!

than air diffusion system

- TESTS PROVE LOWER POWER COSTS!
- LOWER MAINTENANCE COSTS!
- BETTER EFFLUENT

In the selection of sewage treatment equipment, the two most important factors are operating cost and effluent quality.

These figures from the annual report of the Manchester, England, Rivers Department, *prove* the superiority of the Hi-Cone! They're based on the operation of activated sludge plants (including a Hi-Cone System and a diffused air system) under strictly comparable conditions over a period of 18 months. Manchester is a pioneer in treatment by the activated sludge process, having first conducted experiments and tests in 1913.

Hi-Cone's power consumption was lower! Horsepower demand per million gallons treated per 24-hour day for the Hi-Cone System was 34.9% lower than the air diffusion system.

Hi-Cone's total operating costs were lower! Relative costs per million gallons treated were 42.1% lower than the air diffusion system.

Hi-Cone's effluent was better! The B.O.D. reduction was 26% greater; the suspended solids removal was 5% greater than the air diffusion system.

Use this coupon to ask for detailed information

Please send the following descriptive literature on the Hi-Cone:

☐ Cost and operating reports ☐ Report of article, "U. S. and British engineers agree on the Hi-Cone System"

☐ Hi-Cone engineering data

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. . . manufacturers of:
centrifugal pumps • pneumatic sewage ejectors • distributors • clarifiers • mechanical aerators • digesters

Penna. Clean Streams Conference

A river inspection trip and a discussion of safe disposal of radioactive wastes were special features of the Pennsylvania Clean Streams Conference held in Pittsburgh on April 25 and 26.

The conference, fifth in an annual series sponsored by the State Chamber of Commerce and 18 cooperating organizations and agencies, including the Penna. Sewage and Industrial Wastes Assn, and Penna. Water Works Assn., got under way with the welcoming address by W. F. Rockwell, Jr., President, Penna. State Chamber of Commerce.

The handling and disposal of radioactive wastes, a subject of growing importance because of nuclear power and other industrial atomic projects in western Pa. and elsewhere, was discussed by Dr. Joseph A. Lieberman, of the Atomic Energy Commission, Washington.

Other speakers at the Mellon Institute sessions described waste disposal developments in the steel and food industries.

For the river tour, passengers boarded a U. S. Steel Corp. river boat at the Sixth Street Wharf in Pittsburgh. The boat, pulled by a diesel tow boat, cruised Pittsburgh's famous Monongahela and Ohio river system from 10 A. M. to 4 P. M. with luncheon served on board.

N. E. Section AWWA Elects Officers

Hears brief report on polyelectrolyte coagulant aids

At the annual meeting of the New England Section of AWWA, the following officers were elected for the ensuing year:

Chairman: Peter C. Karalekas, Chief Engr., Water Works, Springfield, Mass.

Vice Chairman: Herman Burgi, Jr., Gen. Manager, Portland Water District, Portland, Me.

Secretary: J. E. Revelle, Dist. Sales Mgr., Chicago Bridge & Iron Co., Boston, Mass.

Trustees: Clarence L. Ahlgren, Asst. Supt. and Ch. Engr., Water Works, Manchester, N. H.; A. J. Minkus, Engr. of Purif., Water Bureau, Hartford, Conn.

The George W. Fuller Award Committee selected ARTHUR D. WESTON, Cons Engr., Edgartown, Mass. Mr. Weston was Chief Sanitary Engineer for the State of Massachusetts until his retirement a few years ago.

AWWA Secretary Harry E. Jordan attended the meeting and reported that the New England Section had grown from 214 to 246 in the past two years.

Mr. Jordan also reported on the matter of highway reimbursement legislation and on the matter of new coagulant aids. In reference to polyelectrolyte coagulant aids, Mr. Jordan said that many state health departments are becoming apprehensive as to the toxicity of these compounds. AWWA is planning a referee board on this matter; the board will consist of two U.S.P.H.S. men, two independent laboratory men, and one university man. Any persons having data on the topic are asked to submit it to the board.

Note special architectural effort to keep this building in harmony with its residential surroundings.

Hill Road Reservoir of Washington Suburban Sanitary Commission Served by WHEELER-ECONOMY PUMPS

One of the world's largest all-steel reservoirs is the new Hill Road Station built for the Washington Suburban Sanitary Commission in Prince George's County, Md. It has a capacity of ten million gallons. Three Wheeler-Economy Horizontal Double Suction Pumps draw water out of the reservoir and lift it into the supply system. Two of the pumps are 10" x 8", with a capacity of 3500 gpm each at a head of 235', 1750 rpm. The third pump is 8" x 6", 2000 gpm capacity at 200' head, 1750 rpm.

Wheeler-Economy Double Suction Pumps are custom built to meet your specific conditions for most dependable water works service. Case is horizontally split so top half may be lifted for access to rotating parts without disturbing piping or driver connections. Parts are standardized and accurately machined for quick replacement when necessary. Simplicity of design, quality of workmanship and materials give these pumps their reputation for long lived dependability, sustained high efficiency with low maintenance. Many have been pumping for 25 years and more without replacement of major parts. That's why so many Wheeler-Economy Pumps are going into modern water works systems. Have you talked to a Wheeler representative? There's one near you.

Write for Catalog A-156.

Wheeler-ECONOMY PUMPS

C. H. Wheeler Manufacturing Co. • Economy Pump Division

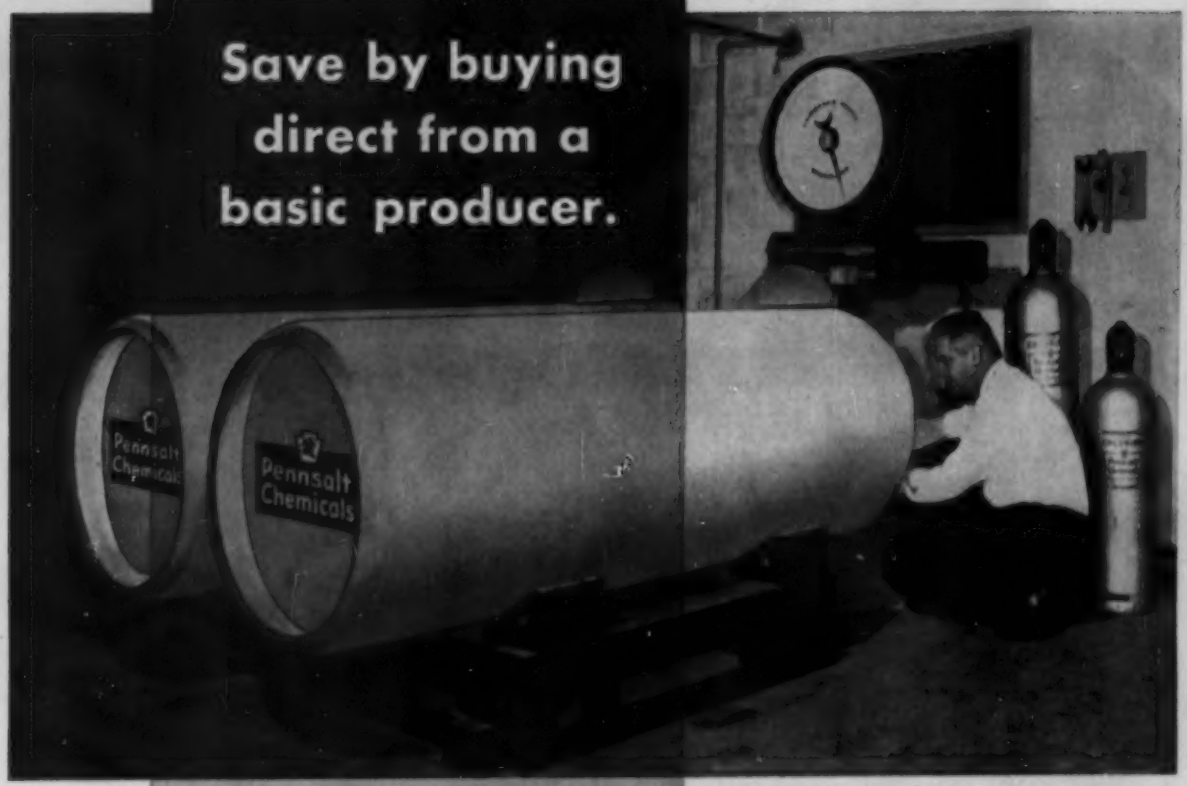
19th and Lehigh, Philadelphia 32, Pa.

Could Be!

The reason why some people get "lost in thought" is because it is unfamiliar territory to them.

Many of us never put our best foot forward until the other one gets into hot water.

Save by buying direct from a basic producer.



Mr. Harry S. Fisher, Pennsalt Technical Service Engineer, inspecting ton chlorine container installation at City of Eugene, Oregon, chlorination station.

Many municipal, co-operative, and private water systems buy chlorine and other water and sewage treatment chemicals direct from PENNSALT for the simple reason that they save money by buying direct and taking advantage of Technical Service assistance.

TECHNICAL ASSISTANCE

. . . is so important to users of chlorine and other water and sewage treatment chemicals that some municipalities require this service to be written in their bids. It means PENNSALT not only provides constantly high quality chemicals, but also Technical Service Engineers "on your staff but not on your payroll." There is no extra cost.

THE BIG 3 PENNSALT CHEMICALS for Water and Sewage Treatment

1. **CHLORINE**—A uniform quality water works grade of chlorine. Used by scores of cities and communities throughout the West because of confidence in PENNSALT'S Quality Control of the product. Shipped in 100 and 150 lb. cylinders and ton containers by rail, truck and water.
2. **AMMONIA,** Anhydrous — Water works grade, shipped in modern bottle-type cylinders which lighten the burden of handling. 50, 100, 150 lb. cylinders.
3. **PERCHLORON®**—High-test calcium hypochlorite containing 70% available chlorine. Shipped in 100 lb. drums; cases — nine 5 lb. cans to case.

WESTERN DIVISION
PENNSALT CHEMICALS CORPORATION

(Formerly Pennsylvania Salt Manufacturing Company of Washington)

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Pennsalt Chemicals

• For further information on products or services please use reader service card.

W&SW

New Equipment

Pressure Transmitter

501

The Foxboro Company, Foxboro, Mass., has developed a new, inexpensive indicating pressure transmitter, accurate to ±½% of scale range. Known as the Model 44 Pressure Transmitter, it measures pressures of 0-30 inches of water to 0-6,000 psi, transmitting a 3-15 psi air signal to indicating, recording or controlling instruments.

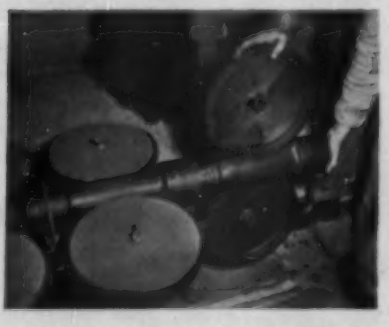
To accommodate the various ranges, a choice of standard Foxboro pressure elements is offered —spirals, helicals, bellows and diaphragms; element materials are available for corrosive process fluids.

Eliminating the need for a separate field gauge, the transmitter has an eccentric indicating scale, 4½" long, built into the front of the case. Red pointer and black-on-white scale markings are visible from as far away as 20 feet to provide indication at point of measurement.

Circular Diffusers With Carborundum Plates

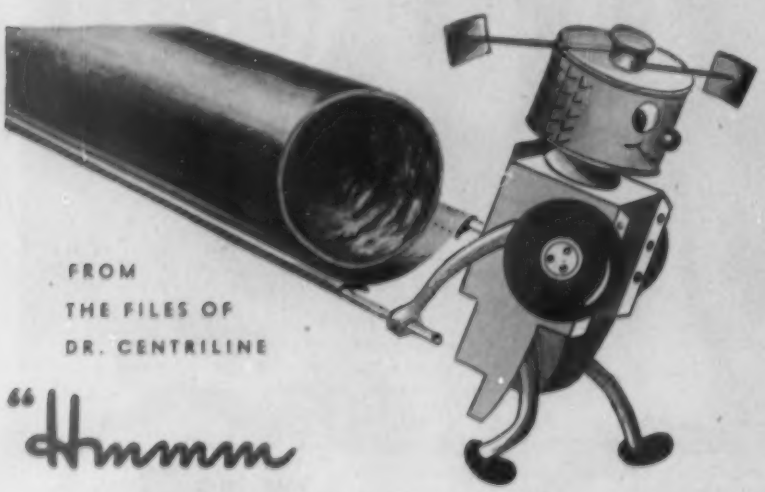
502

Pacific Flush Tank Company, Chicago, Ill., has developed a new type of aeration plate holder that permits the servicing of air diffusion assemblies without dewatering, or removing the aeration tanks from service.



No tools are necessary with the new holders. The carborundum plates are quickly installed or replaced by hand. A single bolt and wing nut holds the entire assembly in place.

The new circular plate holders are made from an inert material that is not affected by alkaline or acid which may be present in sewage. Designed specifically for operation in the P.F.T.-Kraus Dual Aeration System, the new holders are also efficient and economical in any aeration system using air from blowers.



FROM
THE FILES OF
DR. CENTRILINE

"Hmmm ...a bad case of corrosion"

CASE #7841

PATIENT: 8 Miles of 16" and 12" Cast Iron Water Supply Lines in Abington-Rockland (Mass.) Water District.

SYMPTOMS: Lack of water and pressure during periods of high demand requiring restrictions in the summertime.

DIAGNOSIS: Poor circulation due to regrowth of tuberculation after cleaning. Available water could not be delivered to consumers.

TREATMENT: The lines were cleaned and cement lined in place without interrupting service to consumers. In less than 8 weeks the entire job was completed.

RESULTS: Patient now sound and healthy; pipe capacity permanently doubled, no further summer restrictions, future maintenance costs were eliminated.

If your lines also show signs of suffering from corrosion, leakage or tuberculation, investigate the Centriline Process. Cleaning and cement lining in place has been a successful remedy for over 1,000 miles of water supply pipelines. Centriline hasn't lost a patient yet.

CENTRILINE CORPORATION

A subsidiary of the Raymond Concrete Pile Company

140 CEDAR STREET, NEW YORK 6, N.Y.
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Branch Offices in Principal Cities of the United States, Canada, and Latin America.

VALVE BODY
Cast iron flange and body thickness equal to or greater than called for by AWWA Specifications. Standard laying lengths.
VALVE SEAT
Molded natural rubber (or similar material) reinforced with stainless steel inserts . . . cemented and screwed in place for complete immobility. Permits valve relocation without difficulties encountered with spool-type liner valves.
TWO-WAY THRUST BEARING
Keeps valve disc centered regardless of valve position and absorbs any unbalanced axial thrust developed by static pressure acting on the valve shaft.
STUFFING BOX
Liner design keeps stuffing box unloaded . . . this, plus only 90° rotation of shaft, virtually eliminates leakage.
SOLID STAINLESS STEEL SHAFT

REDUCE MAINTENANCE COSTS

with Builders Butterfly Valves

Available with all types of manual and power operators, including Builders own "lo-head" cylinder operator.

Strict adherence to sound engineering and advanced hydraulic principles accounts for the high durability of Builders Butterfly Valves. These design features, plus extra-sturdy construction result in valves which last the life of the plant and require minimum maintenance.

Remember, too, that these Butterfly Valves are backed by Builders specialized knowledge of water and sewage works metering and control problems. Builders Butterfly Valves are built to AWWA specifications . . . for water and sewage works service.

For Bulletin 650-L1B, write
BUILDERS-PROVIDENCE, INC.
350 Harris Ave., Providence 1, R. I.

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
METERS RECORDS CONTROLS

"O" Rings And Brass Parts Added to Crane Valves

503

Crane Co., Chicago, Ill., has added two alternate features to its line of A.W.W.A. iron body double disc gate valves.

Crane A.W.W.A. gate valves in sizes 2, 3, 4, 6, 8, 10, and 12 inches, are now available with "O" ring stuffing box and all-brass internal parts.

The "O" ring is offered with Crane's line as an alternate to the conventional stuffing box. It consists of two Buna-N rubber "O" rings around the stem in the stuffing box. The lower ring acts to seal internal pressure, while the upper ring serves as a reserve pressure seal, and as an external dirt seal.

The all-brass internal parts are offered with Crane A.W.W.A. valves for use on water services where a critical corrosion problem exists. The brass internal parts include body rings, discs, upper and lower spreader and gland—plus a Ni-Vee Type "A" bronze stem.

here's all the equipment you need to sanitize with HTH

The convenience and the quick, positive chlorine action of HTH Granular make it ideal for water sanitizing at all points from source to faucet. And HTH effectiveness is matched by its economy.

Dry, non-dusty, easy to store and use . . . HTH offers 70% available chlorine for sure elimination of bacteria, algae, fungi and odors from reservoirs, wells, mains, spray ponds, filters and other danger spots.

Call your supply house today. Or write Olin Mathieson directly. You'll be surprised how many water treatment problems you can solve with HTH Granular.

HTH Granular is available in 100 lb. drums and cases of nine 5 lb. cans.

HTH

OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

4363

HTH® is a trademark

Clow Introduces New Cast Iron Pipe Joint

504

James B. Clow & Sons, Inc., Chicago, Ill., has just introduced a new cast iron pipe joint.

This new pipe joint is a rubber seal joint, which uses only a molded rubber gasket for its seal. No follower ring or bolts are required. Its features are fast, simple assembly. The joint has been approved by the Underwriters Laboratories for 350 psi working pressure.

The Clow rubber seal joint is an "all weather" joint, that makes on tight under virtually any or all trench or weather conditions, as a result, speed of laying pipe can be stepped up, and lower cost realized for the completed pipe installation.

Clow is currently in limited production on pipe with this new joint at their Coshocton, Ohio and Birmingham, Alabama pipe plants.

Drum-Type Multiple Indicator

505

The Bristol Co., Waterbury, Conn., has available a new Drum-Type Precision Indicator for quick readings of variables at remote points.

This indicator uses the company's standard Dynamaster electronic instrument components. It is equipped with numbered push button switches on the front of the case, and can scan up to 48 remote points quickly. The revolving drum-type scale has a calibrated length of over 26 inches. Full-scale travel takes place in 4½ seconds.

10-Ton Manifold for Concrete Pipe Line

This reinforced concrete manifold ties four 30-inch water lines into a 54-inch line in a new water supply system in Illinois.

Two 20-foot I. D. intake caissons in the east bank of the Mississippi at Granite City, Ill. feed the four 30-inch lines, which in turn feed the manifold. The 54-inch line from the manifold runs three miles across town to a ten million gallon reservoir. The water is then distributed through 24-inch lines to meet the increased requirements of the two plants of the Granite City Steel Company.

Ranney Method Water Supplies, Inc. of Columbus, Ohio sank the caissons. The Dayton, Ohio plant of Price Brothers Company manufactured the concrete pressure pipe and the special fittings used on the job. The 24 and 30-inch lines are prestressed concrete cylinder pipe and the 54-inch line is concrete embedded cylinder pipe. Concrete pipe was selected for this project because of its high strength, continued high capacity, long life with low maintenance and long term economy.

Price Brothers

Uniform Pipe Marking System

506

W. H. Brady Co., Milwaukee, Wis., has developed the Brady Self-Sticking Perma-Code pipe markers that enables plant and maintenance engineers to standardize the pipe identification system for their entire plant.

The new markers come in stock heights to fit any size pipe. They are made of all-temperature Vinyl-cloth with a heavy-duty all-temperature adhesive, and silicone-plastic overcoated for long life. They are guaranteed to stick to pipes for a minimum of 2 years. New, job-tested, bold, black, letters on ASA Standard A-13 background colors identify pipe contents with both color and legend. Matching stock directional arrows indicate flow direction of pipe contents.

A free Pipe Marker Planning Kit is available to help plan a standardized pipe identification system for the entire plant. The Kit includes a planning guide, cost comparison and safety information, application photos, free testing samples and a stock list.

Steel Gate Valves For Butt Welding

507

Crane Co., Chicago, Ill., has announced longer end-to-end dimensions for its cast steel gate valves for butt welding.

The increase applies to Crane's 150 pound cast steel gate valves in sizes from 2" through 24".

The new valves offer greater protection to seating areas against heat distortion during the welding of line connections, and the new and longer dimensions comply with proposed ASA Standard B16.10, given tacit approval by the Manufacturers Standardization Society of the Valve and Fitting Industry.

A 2" valve will now measure 8½" end-to-end, a 10" valve 18" end-to-end, and a 24" vale 32" end-to-end.

Precision Concrete Boring Tool

508

J. F. Hamlin Co., Inc., San Francisco, Calif., has developed the Kor-It, Jr., a core-cutter that drills clean holes in hard surfaces, such as reinforced concrete.

The Kor-It, Jr., small, compact and completely portable, complete with motor and attachments weighs only 36 lbs. Using diamond bits, it cuts holes up to 6 inches per minute in any diameter from 3/16 to 2 inches and is virtually free of noise, mess and vibration. It drills at any angle and up to depths of 8 inches, with extensions to greater depths.

An appealing feature is the way cutting is done to the exact diameter desired, removing the core in a solid piece. No chipping is required.

"Out of sight—out of mind" can be a mighty expensive philosophy in any water distribution system. The above unretouched photograph proves this point. It shows a badly tuberculated *eight inch* main whose *inside diameter was reduced to an average of almost 4.6 inches.* Resultant higher pumping costs with reduced pressure and carrying capacity make it costly to tolerate such conditions. That is why the savings effected in reduced pumping costs frequently pay for the *low cost* of National water main cleaning.

Since there's never a charge or obligation to inspect your mains, *call National now!*

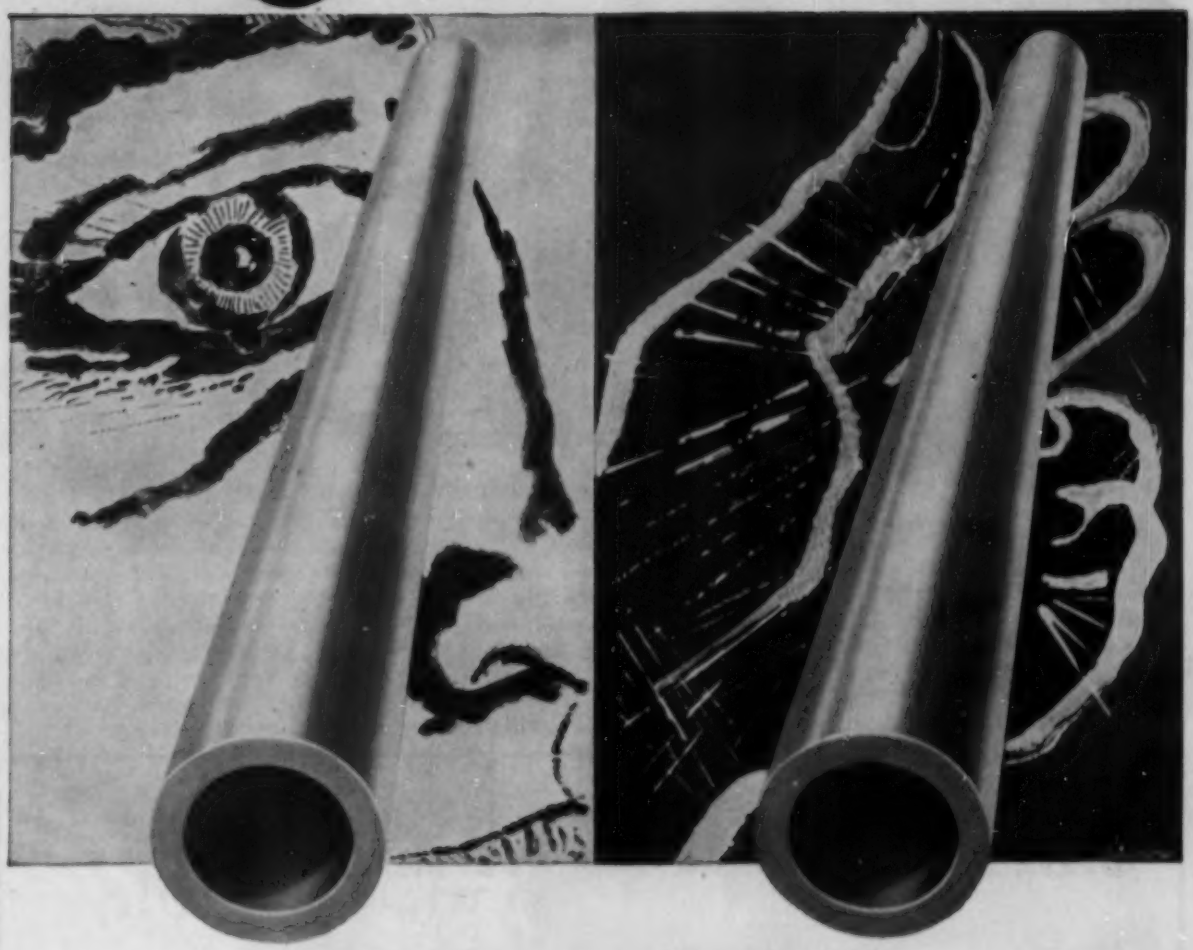
Call in National today!

NATIONAL WATER MAIN CLEANING COMPANY

50 Church Street • New York, N. Y.

ATLANTA, GA; 233 Candler Building • BERKELEY, CALIF; 905 Grayson Street • DECATUR, GA; P. O. Box 305 • BOSTON, MASS; 115 Peterboro Street • CHICAGO; 122 So. Michigan Avenue ERIE, PA; 439 E. 6th Street • FLANDREAU, S.D.; 315 N. Crescent Street • KANSAS CITY, MO; 406 Merchandise Mart and 2201 Grand Avenue • LITTLE FALLS, N.J.; BOX 91 • LOS ANGELES; 5875 Santa Fe Avenue • MINNEAPOLIS, MINN; 200 Lumber Exchange Building • RICHMOND, VA; 210 E. Franklin Street • SALT LAKE CITY; 149-151 W. Second South Street • SIGNAL MOUNTAIN, TENNESSEE; 204 Slayton Street • MONTREAL, CANADA; 2032 Union Avenue • WINNIPEG, CANADA; 576 Wall Street • HAVANA, CUBA; Lawrence H. Daniels. P.O. Box 531 • SAN JUAN, PUERTO RICO; Luis F. Carallni, Apartado 2 84.

USCOLITE PLASTIC PIPE



Look alike... Feel alike

BUT AS DIFFERENT AS DAY AND NIGHT

It's a fact: Given the same raw materials, finished plastic pipe can be as different as day and night. The difference is in the techniques of compounding and manufacture.

For instance, these two lengths of plastic pipe, when new, have the same appearance, the same "feel",,even the same weight. Both are used to carry the same corrosive chemicals. Yet one pipe failed in just a few months—the other pipe still shows no sign of wear after several years of service.

What's the difference? The *long-life* plastic pipe (on the right) is Uscolite®, and that means *quality*—the use of undiluted virgin resins, superior extrusion techniques, precision dimensions, quality control all the way.

When you order Uscolite—either Uscolite CP (modified alloy) or Uscolite RV (polyvinyl chloride)—you're getting plastic pipe with a reputation that has been proven by 8 years of service. And in all that time, *not one foot of Uscolite Pipe has ever been replaced.*

For your next plastic pipe and fitting installation, select carefully—select Uscolite. A complete line of pipe and fittings (including unique UscoWeld® fittings) plus the assistance of trained sales engineers who *know plastics*—is available at the 28 "U. S." District Sales Offices, at selected distributors, or contact us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

Mechanical Goods Division

United States Rubber

Measuring Wheel

509

Rolatape Co., Santa Monica, Calif., has available the Rolatape Measuring Wheel for job applications such as, physical inventories, leakage surveys, street opening surveys, locating paving cuts, map correction and general estimating work. The wheel measures around corners, contours with equal facility and accuracy.

With a Rolatape you unfold the handle, set the counter and begin walking. Rolatape does the measuring. For longer distances the Rolatape can be operated by the driver of a car as he drives slowly over the course to be measured.

Challenge Trencher Now In Production

510

Challenge Manufacturing Co., Los Angeles, California, recently introduced a new ladder type trencher, designed for universal application. It economically digs square or round bottom trenches of any size between 12" and 18" wide and to 5'3" deep . . . either in a perfectly straight line or any desired radius. Nine travel speeds and eighteen trenching speeds offer a wide range of operating flexibility.

The "Challenge" is a gear (fully enclosed) driven, track-laying trencher with low ground bearing. It will operate over soft terrain, cross open trenches and go where other type trenchers would bog down. Tracks are self-cleaning.

A hydraulically controlled 5'8" backfill blade is standard equipment and permits the operator to clear a path ahead of the trencher . . . level off high spots . . . and refill trenches.

The "Challenge" also features an exclusive depth indicator which enables the operator to determine the exact depth of the trench without stopping the digging operation.

Electro-Pneumatic Positioner For Control Valves

511

Conoflow Corporation, Philadelphia, Pa., has available a new electro-pneumatic positioner as an integral component of Conoflow series LB control valves.

The Model "E" Electro-Pneumatic positioner provides valve positioning which is directly proportional to DC signals received from electronic instruments. No electro-pneumatic transducer is required; full 100 psi plant air supply can be used. The electro-pneumatic positioner possesses all of the rigid operating characteristics of the LB valve's standard pneumatic positioner, insofar as sensitivity and stability are concerned, and eliminates the inherent transmission lag of all-pneumatic systems.

"DIXIE'S NATIONWIDE SERVICE SATISFIES"
THE SILENT WATCHMAN
The largest water tank repair company in the United States is at your service. Repairs guaranteed for 12 years—paint for 3 years.
Representatives in every state of the Union.
DIXIE TANK'S "SYMBOL" OF YOUR PROTECTION
DIXIE TANK & BRIDGE CO.
P. O. BOX 14, MEMPHIS 1, TENN.
Please write or wire us for more information.

Inside.....Outside....

...you'll find DeZurik Valves throughout the modern sewage plant at Caney, Kansas.

In many new sewage plants throughout the country, as in this one, DeZurik Easy-Operating, Non-Lubricated Plug Valves are in operation on a number of services. (These photos taken at Caney, Kansas, Sewage Treatment Plant; Consulting Engineers, Pate Engineering Company of Tulsa, Oklahoma; Contractor, Freeto Construction Company of Pittsburg, Kansas.) At Caney, these versatile valves are on the job throughout the plant—on sludge draw-off and re-circulation lines, controlling sewage flow and sludge draw-off through adjacent primary and final settling tanks, controlling sludge flow from digesters to drying beds, and many more services!

Engineers specify DeZurik Valves because their dependability has been proved again and again in plant after plant.

Plant personnel prefer DeZurik Valves for their easy operation, freedom from maintenance and elimination of leakage.

DeZurik Valves are the *only* easy-operating, non-lubricated plug valves with eccentric action! They open easily—close tight—despite solids in the flow—and require an absolute minimum of maintenance.

If you're planning a new plant—or specifying new valves—get complete details on DeZurik Valves. Representatives in all principal cities, or write to

DeZURIK CORPORATION
SARTELL, MINNESOTA

Worthington Announces New Comminutor

512

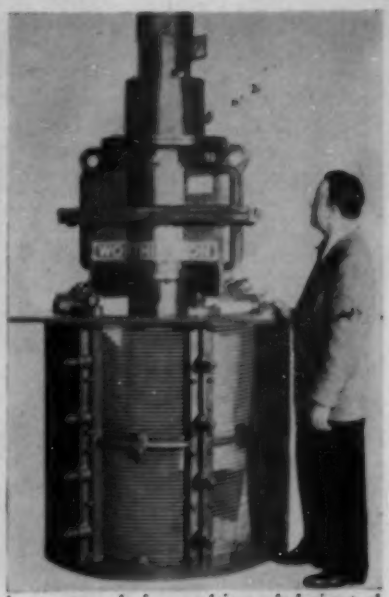
The Public Works Department of Worthington Corporation, Harrison, N. J. has announced that a new 36" Comminutor has been added to their present line of 15 and 25 inch comminutors.

This latest addition was especially developed to handle flows up to 26 MGD. It is recommended for use wherever the maximum flow exceeds 11 MGD.

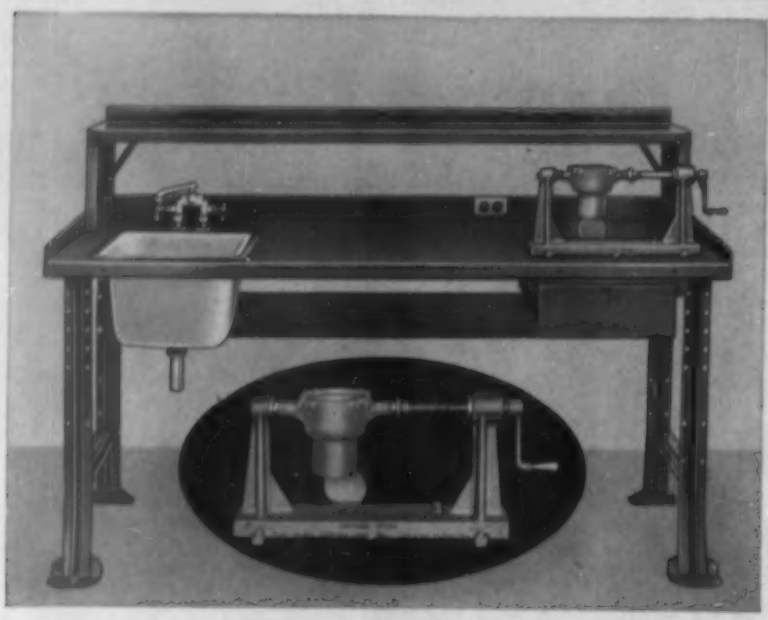
Powered by a 2 HP gear-motor, the new Comminutor is equipped with an oscillating cutting arm which travels back and forth across the entire screen 8.7 times per minute. Coarse solids are reduced small enough to pass through the comminutor's screens (which have ½ inch slots) without removal from the sewage flow.

It is designed to fit into either a new or existing 4 foot wide straight rectangular channel having a recommended minimum depth of 54 inches.

The 36 inch Comminutor is available either as a close coupled or



long coupled machine, lubricated by grease or oil as desired. The unit is protected against flooding by a mercury seal which will keep out sewage up to 30 feet of submergence.



METER REPAIR BENCH . . .

Complete with Vise and Sink

Send for Ford Catalog No. 56.

Here is a repair bench designed specifically for the water meter shop. A 34" x 72" working top supports a 15" acid resisting sink, a meter vise that holds meters from ⅝" to 1" in size and a tool drawer. Above the bench is a shelf. Bench may be equipped with pressed wood top, two drawers or two shelves if desired. Electrical and air hose connections are standard equipment. Complete information gladly supplied.

FORD

FOR BETTER WATER SERVICES

THE FORD METER BOX COMPANY, INC. Wabash, Indiana

Corrosion-Resistant Valve With Full Flow Passage

513

The Walworth Co., New York, N. Y., has introduced an all-plastic Y-Globe valve with full flow passage.

Made of rigid polyvinyl chloride the new PVC valve provides tight shutoff and flow control of alkalis, acids, inorganic salt solutions and other corrosive fluids.

The new valve, non-toxic as well as non-corroding, assures fluid purity. A special bonnet and gland nut design provides an aboslute leakproof unit. Because of its sturdy construction, the valve will operate successfully at pressures up to 150 psi at 75°F.

Sensitive Variable Speed Drive

514

U. S. Electrical Motors Inc., has developed a variable speed drive capable of maintaining any speed in its range within ¼ of 1% accuracy regardless of load fluctuations.

This packaged system consists of a Varidrive variable speed motor and the new speed sensitive Varitrol automatic control package. Speed sensitive Varitrol operates

(*Continued on page 126A*)

In Bay Village, Ohio—Cuyahoga County Engineers combat corrosion with over 37 tons of wrought iron plate for 48-inch sewage line

Corrosive threat plus inaccessible location added up to Wrought Iron for 48" O.D. sewage line

There was no question about the corrosion factors involved in the sewage line planned to serve Bay Village, Ohio. Compounding the problem was an almost inaccessible location that would make repair and maintenance difficult and expensive. And added to these considerations was the need for a material with sufficient structural strength to permit a 60-foot span between two trusses on either side of the valley the line had to cross. Cuyahoga County Sanitary Engineers, under the direction of Mr. John Puzenski, answered all these requirements with wrought iron. More than 37 tons of ⅛-inch wrought iron plate was fabricated into 48-inch diameter pipe and installed in approximately 270 feet of the sewage system.

Morgan Steel Products, Inc., Cleveland, Ohio, handled the fabrication. Installation work was done by The Utilities Construction Company, Cleveland, Ohio.

Our bulletin, *Wrought Iron for Sewage Treatment and Disposal Installations*, gives complete details on wrought iron's ability to last longer, at lower cost per year. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N. Y.

Available in Canada and throughout the world

BYERS *Wrought Iron Tubular and Hot Rolled Products*

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

Installation of 18" Pratt High Pressure Rubber Seat Butterfly Valve in prestressed concrete water main, Mansfield, Ohio. Engineers: Shaffer, Parrett and Associates.

MANSFIELD...Pratt Butterfly Valves meet all specs for distribution service

The real test of a distribution valve is its ability to operate when needed. Valves in water distribution service are primarily emergency measures, normally left either open or closed for months, or even years. Yet, they must operate when needed, often to prevent serious property damage in the event of a broken water main.

Mansfield engineers chose Pratt High Pressure Rubber Seat Butterfly Valves for this rigorous duty because Pratt valves meet all specifications for distribution service. The critical disc edge is a corrosion-resistant material, seating against a heavy, mechanically retained rubber liner to provide **permanent, drop-tight shutoff.** The stainless steel valve shaft rotates in bronze bearings, self-lubricated for life, and the valve operator is permanently lubricated and sealed. These features are your assurance of easy operation when you need it... features that are built into Pratt valves with the experience that comes with 30 years of leadership in butterfly valve design. Specifying Pratt valves puts this experience to work for you.

See us at the
A.W.W.A. Convention
in **BOOTH 604,**
Atlantic City, May 12 thru 17

HENRY PRATT — RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

on a tight loop, high response, feedback principle. This pneumatic control offers the advantages of low initial cost in comparison to comparable equipment, simplicity of construction and operation, minimum of maintenance, and inherent explosion-proof characteristics.

Alarm Device For Automatic Demineralizing Equipment

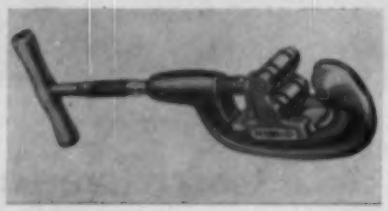
515

Infilco Inc., Tucson, Arizona, has developed the Robotel controller, a signaling system which provides an alarm and record of the malfunctioning of any component in demineralizing equipment, which is intended to operate in accordance with a predetermined program. It also provides for automatic shutdown of the programmed operation, if desired.

The Robotel controller immediately indicates, alarms and records the location of the function failure, thus making possible its speedy correction.

Wide-Roll Pipe Cutter

516



The Ridge Tool Co., Elyria, Ohio, has developed a wide-roll cutter, for heavy duty use and easier, better pipe cutting with a power drive.

Extra wide roll built into the cutter features double the bearing surface on pipe. New wide-roll sets and holds revolving pipe at a perfect right angle. The user is thus assured of quick, clean starts for perfect tracking and straight cuts. Time consuming changes to special rolls are not necessary.

Larger screw handle provides easier cutting adjustments for hand or power use. Extended shank protects screw threads from damage by power drive support bar, and gives greater thread bearing surface for easy turning into the pipe cut.

City of Sidney, Ohio

Gets Smooth Measurement of Sludge Magnetically!

. . . WITH FOXBORO MAGNETIC FLOW METER

"The Foxboro Magnetic Flow Meter on return activated sludge went into operation so smoothly that no one paid any attention to it. They haven't done a thing to it since, and it's still operating smoothly."

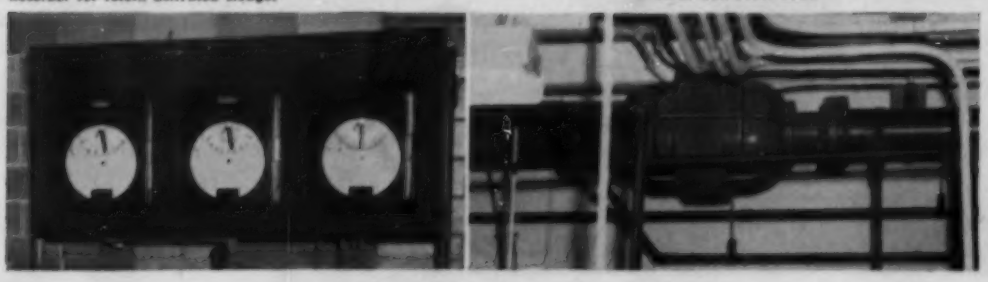
That's the comment of W. D. Sheets of Ohio State University, Technical Adviser for the new Sidney, Ohio, sewage plant. It's a typical perfect-performance report on the Foxboro Magnetic Flow Meter, a modern flow meter that's always easy to install, simple to operate, practically maintenance-free.

No line restrictions — no pressure taps to plug up. With the Magnetic Flow Meter, there's nothing in the line to cause pile-up of solids. And you can forget about purging of pressure taps — there aren't any! Electrical cable carries measurement signal to remote Dynalog* Electronic Recorder, providing a direct magnetic measurement of fluid velocity. Get full details on this unique development in flow meters. Write for Bulletin 20-14A. **The Foxboro Company, 895 Neponset Ave., Foxboro, Mass., U.S.A.**

*REG. U.S. PAT. OFF.

All Flow measurements are recorded by Foxboro instruments centrally located in the plant director's office of the Sidney plant. Shown below, left to right, are: Air Flow Recorder with integrator; Sewage Flow Recorder with integrator; Dynalog Recorder for return activated sludge.

FOXBORO REG. U.S. PAT. OFF. **FIRST in FLOW**



This compact, troublefree Foxboro Magnetic Flow Meter is installed right in the return activated sludge line at Sidney, Ohio's modern new sewage plant. There's nothing in the line to obstruct flow in any way . . . no pressure taps or purges.

It's *New Again* with THORITE and THOROSEAL

Freeze-thaw cycle following water and moisture penetration, also swelling of reinforcing rods from moisture contact, cause masonry destruction.

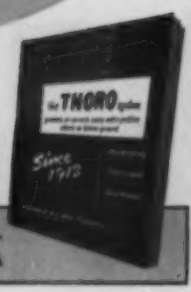
BRIDGE OVER CONCORD RIVER
ROUTE 3, BELLERICA, MASS.

Workmen on scaffold patch spalled and cracked concrete with THORITE and seal surface with THOROSEAL.

Area at left chipped to sound masonry. It will then be patched with THORITE *Nonshrink, Non-slump 20-Minute Set Patching Mortar*, without necessity of costly forming, finished by application of Thoroseal.

Request Circular No. 16 and 20.

Write for our 16 page "How to Do It"



STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNSYLVANIA • CENTERVILLE, INDIANA

New Plastic Resists Hydrofluoric Acid Corrosion

517

Haveg Industries, Inc., Wilmington, Delaware, has developed a new plastic designed to combat the corrosive effects of hydrofluoric acid and other fluorides.

In addition, it will handle fluorine salts, and chemical reactions of HF with organics or inorganics. The material is a graphite filled epoxy resin and will withstand all concentrations of HF at temperatures up to 240°F. in continuous operation. For short-time overloads, the plastic can be subjected to even higher temperatures.

Pipe, pump parts, valves, towers, and tanks up to 10 ft. diameters have already been fabricated with the new plastic.

Indicating Scale and Pointer

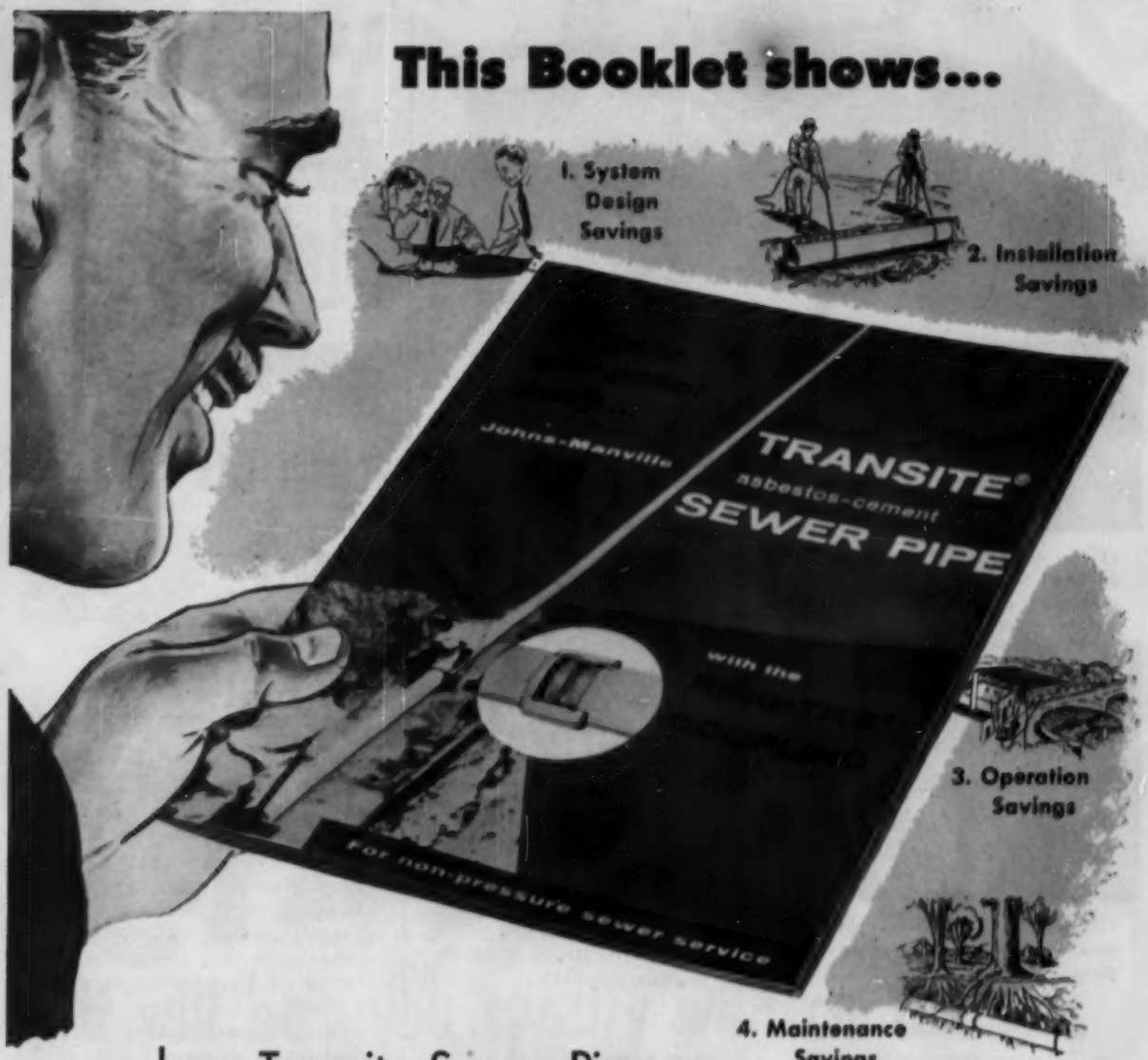
518

The Dickson Co., Chicago, Ill., has announced that a large indicating scale and pointer have been incorporated into the standard Dickson Mindicorder to provide easy reading of temperature or pressure from a distance.

The indicator scale is mounted above the recording chart, and to provide even greater ease in reading, the single door is designed with separate viewing windows. A fluorescent pointer indicates the

temperature or pressure that is being recorded on the chart below. In many instrument applications a clearly legible indication seen from a distance will save operators valuable time.

The pointers and their recording pens are always in sychronization as only one measuring element is used. The pointer and pen arm is mechanically linked to this element.



...how Transite Sewer Pipe saves in **4** important ways

Selecting the right pipe material for a new sewage system—or for additions to an existing one—is a problem of major importance to *all* concerned in influencing a choice. *And* it can be solved to *the complete satisfaction of both installer and user* with economies in each of these stages—(1) system design (2) installation (3) operation and (4) maintenance.

Engineers thinking in long-range terms of thoroughly proved sewer main performance . . . contractors interested in serving community needs at new lows in installed cost—both should know all about Transite® Pipe and the Ring-Tite® Coupling. Here is a new booklet that tells and shows how Transite Pipe reduces infiltration, keeps out roots; maintains high flow capacity; speeds installation; permits designing the system for savings. Send the coupon for it today.

Johns-Manville

TRANSITE SEWER PIPE

WITH THE RING-TITE COUPLING

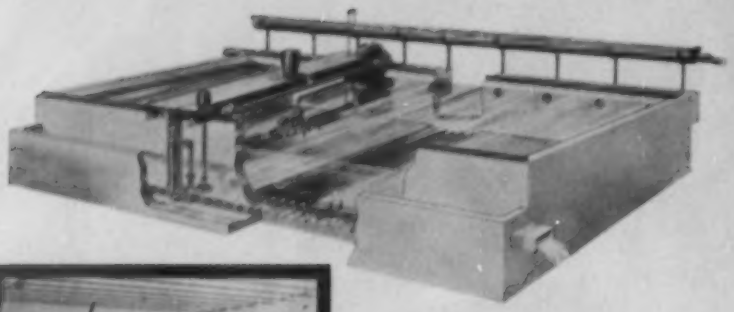
Johns-Manville, Box 14, New York 16, N. Y.

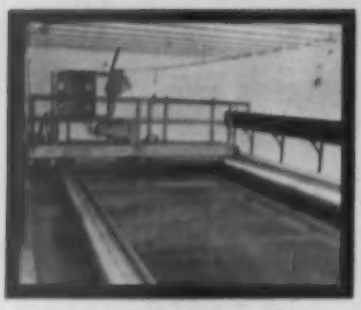
Gentlemen—Please send me your new Transite Sewer Pipe Brochure, TR-165-A.

Name_____ Company_____

Street_____

City_____





12½′ x 40′ Hardinge Automatic Backwash Sand Filter in a municipal water plant in Vermont.

12½′ x 86′ Hardinge Filter handling water supply for a Canadian paper plant.

A sand filter which

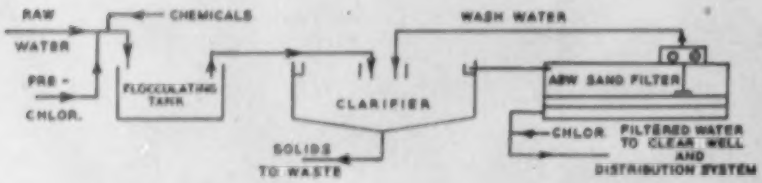
CLEANS ITSELF

The Hardinge Automatic Backwash Sand Filter is a complete departure from standard filtration equipment, in that it backwashes its filter bed automatically without interrupting normal filtration.

The ABW filter in combination with flocculation and sedimentation equipment provides treated and filtered water for municipal and industrial water supplies.

The filter may be applied also for the treating of plant waste water, for reuse or disposal.

Complete specifications upon request. Bulletin 46-A-15



The flow sheet above illustrates the use of a Hardinge ABW Filter, in conjunction with Hardinge flocculating and clarifying equipment, on municipal or industrial water treatment. A modified system is available for liquid waste disposal or reclamation.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

New Backhoe For Light Tractors

519

Shawnee Manufacturing Co., Inc., Topeka, Kansas, has developed a new hydraulic backhoe for light tractors.

Named the "Warrior" the machine is designed for specific types of digging. It digs slightly more than 12 feet below ground surface and has a full swing of 170° through three 120° quadrants of operation. The machine utilizes Shawnee's exclusive push-pull principle which produces digging power of over 4800 pounds at the bucket teeth.

The unit is designed so that the whole unit can be installed or removed from the tractor in a matter of minutes. Individually controlled hydraulic stabilizers align the unit for plumb digging on slopes, with the wheel on a curb, etc. The new unit is adaptable for mounting on all popular makes and models of light industrial tractors.

Kenco Pumps Offers Warranty-Exchange Plan

520

Kenco Pump Division, Lorain, Ohio has announced a utility-sump pump 3-star Warranty-Exchange Plan.

Features of the plan are: 12 month absolute guarantee; 15 minute service call; sliding scale exchange; and the customer pays no more than 44% of the cost of an exchange unit, regardless of the age of the pump.

The 12 month absolute guarantee provides for replacement by an exchange unit at no charge for any pump proving inoperative during the first 12 month period, assuming that the pump has not been damaged by misuse or neglect.

The sliding scale exchange provides that if failure occurs after the guarantee period, the pump is exchanged and the owner credited with an amount that is applied toward the replacement unit. Trade-in allowance is pre-established and recommended by the manufacturer.

Under the 44% maximum customer exchange, the customer pays no more than 44% of the list price of the replacement pump, regardless of the age of the pump. This assumes, of course, that the pump has not been damaged, but has received normal wear.

Mail the coupon for this NEW Crispin AIR VALVE CATALOG it will help you specify with confidence!

WHEN you're specifying — don't start until you have this new Crispin Air Valve Catalog in your hands! Its 28-pages give detailed information on all Crispin service-engineered products that, for over 45 years, have provided safe, precise control of air in pipelines.

This new Crispin Catalog is a 2-color, fully illustrated workbook on the entire line of Crispin Valves. Complete specifications, operating charts and data, and detailed parts lists on the popular and dependable Crispin Air Valves are included. In addition, there's a section on "Special Types of Crispin Valves" and Crispin Slip Joints along with facts on other products made by the Multiplex Manufacturing Company. "How to Order" and "Where to Buy" information completes this useful handbook.

Mail this coupon *today* for your copy of the new catalog—it gives you valuable facts on Crispin Air Valves that provide safe, dependable and economical control of air in pipelines.

Multiplex Manufacturing Company
Dept. B, Berwick, Pennsylvania

Please send me your new catalog.

Name: .....

Company: .....

Address: .....

City: ..... **State** .....

AIR CONTROL VALVES • SERVICED 45 YEARS

multiplex
MANUFACTURING COMPANY
BERWICK, PENNSYLVANIA

★ ★ ★

Control Foam in Your Sewage Aerator with FINE ORGANICS'

FOAMWILT

Here is the efficient solution to foam problems — FOAMWILT — Fine Organics' low cost, easy-to-use product that not only kills off foam, but inhibits its formation.

Fine Organics' FOAMWILT possesses these outstanding properties:

1. Excellent spreading ability
2. Good "knockdown" of foam at ambient temperatures and unaffected by seasonal changes
3. Rapid travel of defoamant
4. Uniformity, stability, and small change in viscosity at temperatures from 0° to +100° F., allowing outside storage at all temperatures (no clogging of valves and pipes, no separation)
5. Pour point minus 25

Fine Organics' FOAMWILT is economical to use, too . . . it eliminates the need for expensive equipment or special training. Feed 0.5 to 1 p. p. m. of FOAMWILT and watch the excellent foam control in your sewage aerator.

Once you use Fine Organics' FOAMWILT, you'll have the efficient solution to your foam suppression problems.

Buy Fine Organics' FOAMWILT for economical and uniformly good control of foam. Write today for more information on satisfied users and economical application methods.

FOAM CONTROL WITH PRODUCT "A" FOAM CONTROL WITH FOAMWILT

FINE ORGANICS INC.

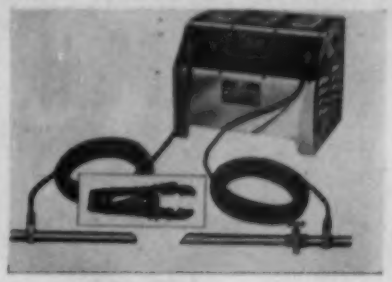
211 EAST 19TH STREET • NEW YORK 3, N. Y.

★ ★ ★

Pipe Thawer Now Used Year 'Round

521

Trindl Products, Ltd., Chicago, Ill., has improved the versatility of the Trindl Therm-O-Tron pipe thawer so that it can now also be



used with a heating attachment for sweating together copper tubes and pipes.

For pipe thawing the Therm-O-Tron is conveniently plugged into any 110 or 220 volt A.C. outlet, the clamps attached to the pipe, and the current turned on. The thawer is supplied with 40 ft. of thawing cable, pipe clamps, and when equipped with the heating attachment it can be utilized constantly throughout the year.

Tubing Cutter

522

The Erie Tool Works, Eire, Pa., has developed a new Pipemaster tubing cutter for non-ferrous and plastic tubing and thin wall conduit.

The new tube cutter's range of operation is ⅛ to 1-⅛ inches OD. It is designed so that all cuts are straight and smooth without distorting the tubing out of round. It will operate with minimum effort.

The screw mechanism is enclosed in a precision-made casting and the safety pivoted reamer swings back out of the way when not in use. The tool weighs only 10 oz. and its overall length is 4-½ inches.

WELL, I promised the boss that we'd come out even on the pipe: so what else could I do?

New Subscription Order Card

NOTE THE NUMBERS
they correspond with the
headings in our
EQUIPMENT AND LITERATURE COLUMNS
To receive further information
on any of the listed
EQUIPMENT OR LITERATURE
just circle the corresponding
numbers on the card
Fill in your name, address, title
and mail!
For your convenience these
cards require no postage.

Water & Sewage Works

185 NORTH WABASH AVE. CHICAGO 1, ILL.

Gentlemen:

Please enter my new subscription to WATER & SEWAGE WORKS for the period checked below:

☐ Three Years—$10.00 ☐ Two Years—$7.50 ☐ One Year—$5.00

Above rates are for U.S.A. and Canada. Add $1.00 per year for other countries.

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Address _____

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508	509	510	511	512	513	514
515	516	517	518	519	520	521
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529	530	531	532	533	534	535

IF YOU WISH TO RECEIVE FURTHER INFORMATION ON PRODUCTS ADVERTISED OR REFERRED TO IN THE ARTICLES, OF THIS ISSUE—LIST THE PAGE NOS. BELOW.

_____

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Your Name _____

Title _____

Company or Dept. _____

Address _____

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*ITEMS LISTED NOT SERVICED AFTER JUNE 30, 1957

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 4868, Sec. 34.9, P.L.&R., Chicago, Ill.

WATER & SEWAGE WORKS
185 NORTH WABASH AVENUE
CHICAGO 1, ILLINOIS

Postage Will Be Paid by Addressee

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BUSINESS REPLY CARD
First Class Permit No. 4868, Sec. 34.9, P.L.&R., Chicago, Ill.

WATER & SEWAGE WORKS
POST OFFICE BOX 123
BALDWIN, NEW YORK

Postage Will Be Paid by Addressee

New Subscription Card

for

WATER & SEWAGE WORKS

JUST CLIP THESE CARDS MARK AND MAIL— TO RECEIVE THE LATEST INFORMATION OR LITERATURE DESCRIBED IN THIS ISSUE

READER SERVICE CARD for

WATER & SEWAGE WORKS

Equipment — Products
Information — Literature

W & SW Manufacturers' News

New Office Addition For Hardinge Co.

Hardinge Company, Inc., York, Pa., has recently broken ground for an addition to their main office on Arch Street in York. It will provide a two-story addition adjoining the west side of the present office building.

The existing offices will also undergo extensive renovations and improvements. The Arch street exterior of new and old buildings will be "streamlined" into a single, combination aluminum and brick front, and the entire structure will incorporate year-round air conditioning.

General Filter Co. 7th Sales Conference

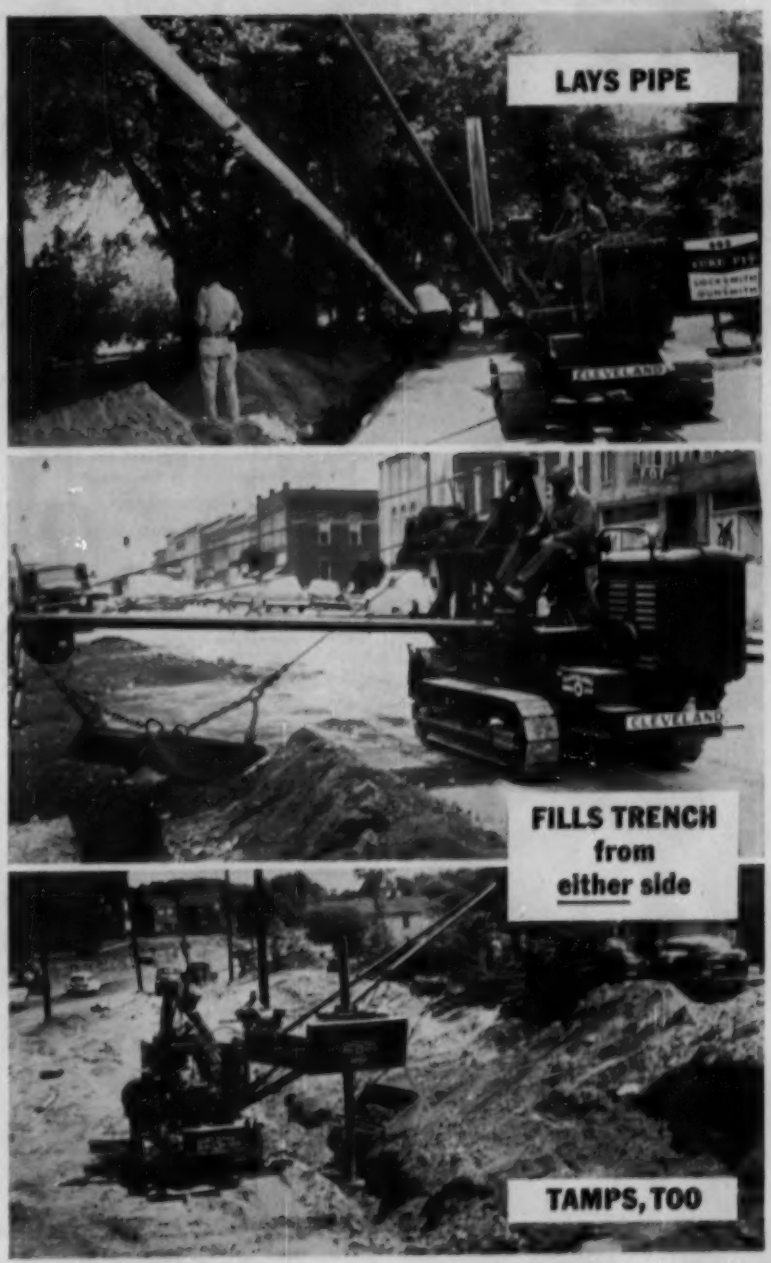
During the middle of February, the General Filter Co. of Ames, Iowa held its annual Sales and Technical Conference. Sales representatives of the Layne-Bowler Co. also attended the meeting. Sixteen states and two Canadian provinces were represented by persons in attendance.

B-I-F Transfers Harris To Providence

B-I-F Industries, Providence, R. I., has announced that Walter A. Harris of Rumford, R. I. has been transferred from B-I-F Industries of Canada, Ltd. to the home office in Providence. He is assuming the duties of Sales Engineer on Synchro-Scan Supervisory Control Systems manufactured by Builders-Providence, Inc.

Mr. Harris was trained as a mechanical engineer at the Naval Engineering College in Canada. His previous experience includes supervisory duties in filtration plants, sales and service engineering experience, and work as a Sanitary Engineer. His professional affiliations include the Instrument Society of America, the American Microscopical Society, the Canadian Institute on Sewage & Sanitation, and the AWWA (Canadian Section).

The Cleveland 80W ...a real money maker



Does All 3 Jobs Better...with Only 1 Man

THE CLEVELAND TRENCHER CO.
20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

Good Everywhere

Sparling Meters

FOR INFALLIBLE MEASUREMENT OF WATER

24-HOUR WATCH!

Guard your water volume with a certainty that every gallon of water is accounted for in your absence at the measuring station. Sparling Meters are tamper-proof. They are highly resistant to normal water corrosion.

Measuring 2" flow or a river

Metering with Sparlings extends over the widest volume range. Closed pipe and maintine, open flow. The superior advantages of the Sparling propeller principle insure lowest cost accurate measurement, as proved by countless case reports.

Mail Coupon for Factual data

SPARLING METER COMPANY INC.

225 N. Temple City Blvd., El Monte, Calif.

ATLANTA 3, 66 Luckie St. N.W.
CHICAGO 6, 220 So. State St.
CINCINNATI 2, 526 Broadway
DALLAS 1, 505 No. Ervay St.
KANSAS CITY 6, MO., 8 E. Eleventh St.
ROMFORD, ENGLAND
LOS ANGELES 54, 945 No. Main St.
ROSELLE, N. J., 650 First Ave. West
SAN FRANCISCO 24, 65 Industrial St.
SEATTLE 99, 5044 Elliott West
TORONTO, CAN., 207 Queens Quay West
246 London Rd.

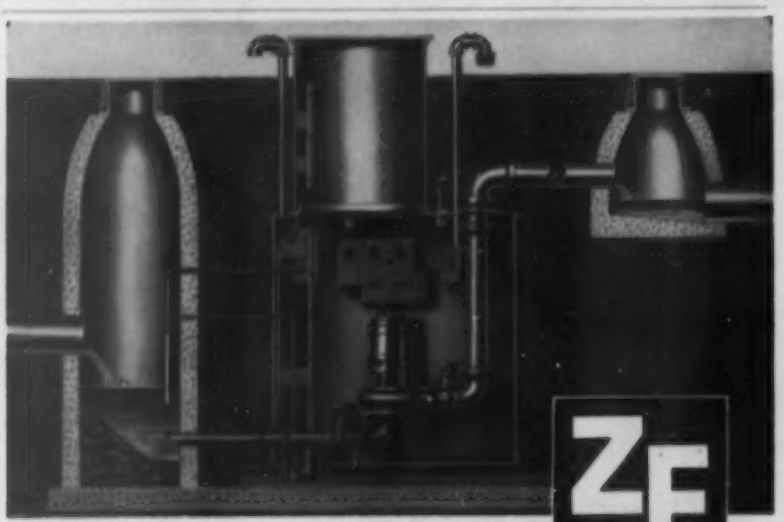
REQUEST FOR LITERATURE

Sparling Meter Company, Inc.
225 N. Temple City Blvd., El Monte, Calif. WSWS

NAME _____

ADDRESS _____

CITY _____ STATE _____



ZF

This prefabricated unit, the Z-F Underground Pumping Station is the answer to most applications

Do You Need a Lift Station?

- Installation can be made with a minimum of time and cost.
- Can be installed on existing public property.
- Entire unit is prefabricated and shop-fitted with standard, well-known equipment.
- Usually can be located at most advantageous spot for existing gradients.
- It is feasible to move and relocate should conditions change.
- Improved equipment, controls and prefabricating technique make the Z-F Station an economical and reliable unit. Write for details. (Territories open for representatives)

Manufactured by ZIMMER & FRANCESCON, Moline, Illinois

Dorr-Oliver Building New Worldwide Headquarters

Dorr-Oliver Incorporated, Stamford, Conn., has recently broken ground for construction of a new two and a half million dollar world-

wide headquarters in Stamford, Conn. Located on an eighteen acre landscaped tract, the new building will provide 120,000 sq. ft. of office space for the estimated 550 home office staff members of the company. Occupancy is expected May 1, 1958.

Designed by Sherwood, Mills and Smith, Architects, of Stamford, the air-conditioned, reinforced concrete building is essentially a two-story hollow square with a loggia in the front facade opening into a central, landscaped court. The new headquarters will house, in addition to top level executive and administrative staff, such departments as Finance, Sales, Advertising, Company Relations, Patent and a major share of the company's technical divisions.

Beckman Expands Fullerton Plant

The Scientific Instruments Division of Beckman Instruments, Inc. Fullerton, Calif., has announced plans for a new $1,500,000 research and development building which will add 100,000 square feet of working area to the present division plant and corporate headquarters in Fullerton.

Construction of the unit, scheduled for completion October 1, will permit expansion of the employee force from 1000 to between 1500 and 1700 persons. It will bring to 304,000 square feet the total operating floor space on the 40-acre Beckman site at 2500 Fullerton Road.

The new building, designed by L. W. Davidson and Associates, will lie parallel to the present 100,000-square-foot research and production building. Joined at the east end, the two structures will form a huge U with a landscaped mall in the center, and the original wing will be devoted exclusively to manufacture.

Santry Elected V.P. and Director of Combustion Engineering

Arthur J. Santry, Jr., secretary of Combustion Engineering, Inc., New York, N. Y., has been elected a vice president and a director of the company.

Mr. Santry is also a vice president and director of Combustion Engineering-Superheater Ltd., of Canada, and a director of Combustion Engineering Corporation, Ltd., of Canada. Mr. Santry is a graduate of Williams College and the Harvard Law School and formerly served with the law firm of Putnam, Bell, Santry and Ray.

Gladding, McBean Promote Broughton

Gladding, McBean & Co., Los Angeles, Calif., has announced the appointment of John R. Broughton as General Sales Manager of the Pipe Products Division.

Mr. Broughton, who has been associated with the company for 7 years, will assume his new duties in addition to his present responsibilities as area sales manager for Southern California.

A registered civil engineer, he is a graduate of Stanford University with a B.S. degree from the School of Engineering, Class of 1942.

Another Florida Office For F & P

Fischer & Porter Co., Hatboro, Pa., has announced the opening of an office in the Carib Theatre Building, Clearwater, Florida. Robert Wenzel, of F&P's Nutley, N. J. office, will use the Clearwater office to cover the area below Levy, Marion and Volusia counties.

This makes the third Florida office for the Hatboro, Pa. organization. Robert Craig represents F&P in Pensacola. William Berglund, District Manager, is stationed at Jacksonville.

NEW TECHNICAL MANUALS ON WATERSTOPS AVAILABLE

We have prepared, in conjunction with various testing companies, a series of factual, technical reports on the subject of waterstops. These Technical Reports cover the many aspects of adequate concrete joint design and should prove to be a valuable addition to your design files. Although these reports are strictly technical information and not sales catalogs, they conclusively prove that DURAJOINT and DURASEAL PVC Waterstops are the only waterstops on the market that will produce a practically 100% watertight joint. Check the coupon below for your free copies of these Technical Reports. Why not mail it now while you are still thinking about it?

DURAJOINT TECH-TIPS

. . . a series of Technical Data Sheets that contain complete information on the design, handling, splicing, installation and structural recommendations on the application of DURAJOINT and DURASEAL Waterstops. Send coupon today for your free set of DURAJOINT "Tech-Tips."

NATIONAL DISTRIBUTION

"DURAJOINT" enjoys national distribution through the distributors of Tecon Inc. in the 11 western states and W. R. Meadows, Inc. in the 37 states of the mid-western, southern and eastern portions of the United States.

DURAJOINT TECHNICAL INFORMATION *Center*

121 HILL AVENUE • AURORA, ILLINOIS

Please send me, without obligation, the following:

- ☐ TECHNICAL REPORT NO. 1... How Cross Section Design Affects Bonding to the Concrete.
- ☐ TECHNICAL REPORT NO. 2...Tests and Methods of Testing Polyvinylchloride Waterstops.
- ☐ TECHNICAL REPORT NO. 3...DURAJOINT Tests and Test Results by the U. S. Testing Company, Inc.
- ☐ TECHNICAL REPORT NO. 4... Hydrostatic Pressure Tests on DURAJOINT and other Waterstops.
- ☐ DURAJOINT "Tech-Tip" Series.
- ☐ Have representative call.

DEPT. 30

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

B-I-F Appoints Lindsey and Morey Regional Engineers

B-I-F Industries, Inc., Providence, R. I., has announced that Ray W. Lindsey of Prairie Village, Kansas has been appointed a Regional Engineer and will operate out of the Kansas City office.

Mr. Lindsey, a graduate civil engineer from the University of Minnesota, is affiliated with the Am. Soc. Civ. Engrs., Am. Soc. Naval Engrs., National Soc. of Professional Engrs., Missouri Soc. of Professional Engrs., AWWA, and the Missouri Water & Sewage Conference.

Edward F. Morey, Jr., of Dallas, Texas has also been appointed a Regional Engineer for the South Central district. He received his BS in Civil Engineering from Rice Institute in Houston, Texas. He is Vice-President of B-I-F Industries of Texas, Inc., a subsidiary, a member of the FSIWA, the AWWA, and is a Registered Professional Engineer, State of Texas. Mr. Morey will operate out of the Dallas office.

Blakeley Joins Hagan Chemicals

Hagan Chemicals & Controls, Inc., Pittsburgh, Pa., has announced that Christopher P. Blakeley has been appointed chemical products engineer in the boiler chemical sales department.

In his newly-created position, Mr. Blakeley will promote the sale of coagulant aids. He comes to Hagan from the Hyla Process Division of Salem-Brosius, Inc. Previously he had been employed for 5½ years by the Dearborn Chemical Company, Chicago, Ill.

Mr. Blakeley holds a BS degree in chemical engineering from the University of London, England.

Armco to Build New Plant in Ohio

Armco Drainage & Metal Products, Inc., Middletown, Ohio, has announced plans to build a new $400,000 manufacturing plant at Wellington, Ohio.

The new plant will manufacture corrugated metal pipe and pipe arches, paved pipe and pipe arch, large diameter Smooth-Flow sewer pipe, and pipe fittings. It will also serve as a warehouse for stocks of Hel-Cor pipe, spiral welded pipe, Flexbeam highway guardrail, and sheet piling.

Construction will begin as soon as weather permits, and it is expected that the plant will go into operation in July. The building will be one of the large prefabricated steel buildings pioneered and manufactured by Armco Drainage. It will have 30,000 square feet under roof and locker room and office facilities will be provided.

Hanson and Stafford Join Dresser Sales Staff

Dresser Manufacturing Div., Dresser Industries, Bradford, Pa., has announced the appointments of Robert J. Hanson and Edwin O. Stafford as general markets sales representatives.

Mr. Hanson, with headquarters in Chicago will cover the midwestern states. He was previously employed by Triner Scale & Manufacturing Co., Ludlow Valve Co., and the Central Illinois Gas & Electric Co. Mr. Hanson attended the universities of Cincinnati and Wisconsin.

WOOD
GATE VALVES

First Choice for Extreme Reliability

Because of their inaccessibility underground, repairs to gate valves are always time-consuming, expensive, and a source of annoyance. And interruptions in service while repairs go on are hazardous for the community.

For these reasons, R. D. Wood Gate Valves are designed to function for generations no matter what the conditions. They are rugged in construction, fully bronze mounted, and tested to 300 lb. hydrostatic pressure. Designed for working pressures conforming to AWWA specifications.

Available with mechanical joint or flange-type pipe connection

SIMPLE IN DESIGN

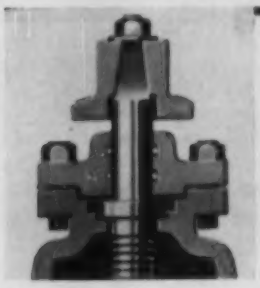
Only three moving parts—a spreader and two discs which are free to revolve their complete circumference while being raised or lowered. Gates are lifted entirely clear of valve openings, providing unobstructed flow.

Mr. Stafford, working out of Houston, Texas will cover the Texas Gulf Coast area. He was formerly employed by the S. and L. Distributing Co. and American Flow Controls, both of Houston. Stafford attended the Universities of Alabama and Texas.

Misrock To Represent Water Service Labs In Virginia

Water Service Laboratories, New York, N.Y., has announced the appointment of Aaron Misrock as engineering sales representative in the Richmond, Virginia area.

Mr. Misrock, whose office is at 728 East Main Street, Richmond, has been associated with the water conditioning industry for many years and has had extensive experience with the problems which are common to water-conveying equipment in commercial and industrial buildings. He is a graduate of the University of Virginia, and was formerly associated with Radford Ordnance Works, Permutit Company and the Cochrane Corporation.



R. D. Wood Gate Valves also now available with O-Ring Stuffing Box seal when specified.

Made by

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

Rockwell Promotes Parker

Rockwell Manufacturing Co., Pittsburgh, Pa., has announced the promotion of Herbert Parker, sales engineer in the Atlanta, Georgia district office, to Atlanta District Manager.

A native of Houston, Texas, Mr. Parker joined Rockwell in January, 1937, in the Houston district office He became a sales engineer in the Houston area in 1940 and later served as sales engineer attached to the Tulsa, Oklahoma district office.

Hydrocrane Distributor Appointed For Georgia

Bucyrus-Erie Co., South Milwaukee, Wis., has announced the appointment of IMC Equipment, Inc., Atlanta, Ga., as Hydrocrane distributor in Georgia.

The firm will handle the truck-mounted all-hydraulic Hydrocrane, and the Hydrohoe, a hydraulically-operated dragshovel.

In serving the entire state of Georgia, IMC Equipment, Inc., maintains headquarters at 720 Spring Street, N. W., Atlanta.

Constantino Joins Water Service Labs.

Water Service Laboratories, Inc., New York, N. Y., has announced that John J. Constantino has joined the chemical department.

Mr. Constantino, a water chemist, was formerly associated with Patuxent Filtration Plant of the Washington Suburban Sanitary Commission at Laurel, Maryland, and prior to that was a water chemist for the Pepsi-Cola company. He is a graduate of Queens College and has done graduate work at the University of Kentucky. Mr. Constantino will make his headquarters at the company's New York office.

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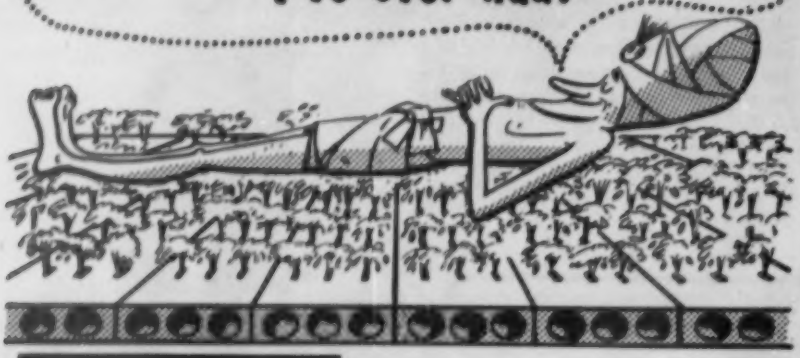

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W&SW

New Literature

Effluent Treatment Plant

523

Infilco Inc., Tuscon, Arizona, has available a reprint of an article dealing with waste treatment in a plant specializing in the manufacture of asbestos paper, entitled **"Sall Mountain's Unusual Effluent Treatment Plant.**

The reprint states that the plant objectives, which have been most satisfactorily realized, were recovery of water for process requirements and reclamation of suspended solids for reuse in paper production.

Relief-Type Fitting For Bearing Lubrication

524

Keystone Lubricating Co., Philadelphia, Pa., has just issued a new 4-page bulletin entitled **"The Keystone RT Fitting . . . . Simplifies Bearing Lubrication."**

This folder describes and illustrates the advantages of Keystone's special relief-type lubrication fitting, which can be easily attached to bearing housings of motors, machines or pillow blocks equipped with conventional relief plugs.

Twenty photographs and drawings show how this new fitting saves time and helps prevent over-lubrication of these ball and roller bearings. Features are illustrated, including the exclusive patented cap that snaps open or shut at the flip of a finger, and the internally flared body for free discharge of excess grease.

A table of test results reveals how Keystone RT Fittings cut lubrication time at least 80 per cent in comparison with conventional relief plugs.

Sewage Pumps

525

The Deming Company, Salem, Ohio, has just published a 12-page bulletin illustrating their complete line of **Sewage Pumps** for industrial, commercial and domestic uses. Included are heavy-duty wet and dry pit sewage pumps, small vertical sewage pumps, and stand-

ard and submersible cellar drainers.

The new bulletin includes performance tables for selecting sewage pumps dimensional drawings, and describes standard construction features. It also lists available control equipment, including float switches, alternator float controls, high water alarm and an automatic lubrication control. It is indexed for easy filing and punched for cataloguing.

Meters, Valves, Regulators
526

Rockwell Manufacturing Co., Pittsburgh, Pa., has just issued a completely revised condensed 28-page catalog covering **Rockwell Meters, Regulators and Valves.**

Some of the new features of the catalog include photo-illustrated descriptions of the recently introduced Rockwell telapilot with power pilot loading by remote control, and the Hypregun, a light compact, efficient air-operating valve lubricant gun.

The catalog also includes completely revised Nordstrom valve specifications and is completely restyled throughout with new emphasis on the use of photo illustrations of all major products described.

Chlordane Insecticides For Your City
527

The Velsicol Chemical Corp., Chicago, Illinois, has just published a brochure containing a wealth of material pertinent to effective municipal insect control entitled **"Here's What Chlordane Insecticides Can Do For Your City".**

The contents include technical bulletins dealing with a wide variety of insect pests, insect habits, insecticide dosages, and other aspects of successful municipal insect control. The subject is treated in considerable detail. The brochure is said to be useful both as a reference volume and a source of information and subject matter for those who plan and conduct meetings on community health problems. It also will serve as a guide in establishing standards for control methods and purchasing specifications which involve the amounts and quality of insecticides that should be used in a municipal insect control program.

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Pneumatic Computing Relay

528

Bailey Meter Company, Cleveland, Ohio, has released a 4-page brochure describing features, applications, and operating characteristics of **Computing Relay For Pneumatic Control Systems.**

The brochure explains proportional, reset, and rate control actions, and provides equations of computing actions.

Venturi Tubes

529

Burgess-Manning Co., Penn Instruments Div., Philadelphia, Pa., has just published a bulletin describing the two available designs of the **Burgess-Manning Venturi Tube.**

Cross section illustrations of both types of the tube are offered. Type PVS is used for sewage and other sediment bearing liquids and is equipped with manually operated cleaning valves at both main and throat annual chambers. Type PVW is recommended for water and other clean fluids.

Prestressed Concrete Tanks

530

The Preload Company, Inc., New York, N. Y., has just released a 4-page bulletin describing **Prestressed Concrete Tanks** for processing plants, water storage and supply facilities, pulp and paper mills, cement plants, and water treatment.

This bulletin covers both design and construction data. Also included is condensed data on the use of prestressed concrete for containment vessels, pressure vessels, silos and shell foundations.

Packless Valves

531

Robertshaw-Fulton Controls Co., Fulton Sylphon Div., Philadelphia, Pa., has just published a 22-page bulletin describing their complete line of **Packless Valves** for applications involving hazardous liquids and gases.

Each valve covered in detail in the catalog contains a metal bellows as the packless feature. More than 20 cutaway views of different packless valve models are included in the 3-color bulletin. Detailed data on specifying and ordering, and charts concerning the application and selection of packless valves, also are included. One chart lists the resistance of various metals used in packless valves to the corrosive action of more than 200 different chemicals and gases.

Venturi Tubes

532

Builders-Providence, Inc., Providence, R. I., has just released a bulletin on the design features, comprehensive dimensional data, capacity tables, recovery tables and similar information on **Venturi Tubes.**

In addition, this two-color, four-page bulletin describes standard, fabricated, and non-standard constructions. It also contains data on the use of valves in the outlet cone, the guaranteed accuracy of these tubes, and the types of accessories available.

Modern Elevated Water Tanks

533

Chicago Bridge & Iron Co., Chicago, Illinois, has just released a 16 page brochure describing **The Watersphere and Waterspheriod, Modern Elevated Water Tanks.**

The modern structures are used in municipal and private water systems to provide gravity pressure for general service and fire protection, and this use is described in the brochure. According to the brochure the Watersphere is offered in standard sizes of 25,000 through 250,000 gallon capacities, and Waterspheroid in capacities of 250,000 through 500,000 gallons. A portion of the brochure illustrates the "skyline advertising" these structures provide municipal, institutional and industrial users.

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pH Electrodes

534

Leeds & Northrup Company, Philadelphia, Pa., has just published a 4-page data sheet giving complete information about **L&N Industrial Process pH Electrodes** and their housings.

This sheet presents engineering features and ordering instructions for dip-type immersion heads, continuous flow assemblies, and the new L&N stainless steel mountings for pipeline pH measurements.

End Suction Centrifugal Pumps

535

The Deming Company, Salem, Ohio, has published a bulletin describing their line of **End Suction Centrifugal Pumps** for general pumping and booster service. Performance tables and dimensions are presented.

According to the bulletin, the compact centrifugals deliver up to 200 gpm with heads up to 70 ft. They are furnished with electric motor or belt drive, with left or right hand rotation. Single and double ball-bearing types are available. Standard equipment includes open type impeller, bolted stuffing box gland and grease lubricated bearings.

Polyken Protective Coatings Catalog

536

The Kendall Company, Polyken Sales Div., Chicago, Ill., has just released a 25-page, 2-color catalog on **Polyken Protective Coatings.**

The catalog is completely illustrated, starting off with the nature of corrosion and its control, then leading into the advantages of wrapping with Polyken polyethylene tape. Diagrams, drawings and descriptive copy are used to emphasize these points.

The tape methods of application to pipe is fully explained; preparation of surfaces, how they are coated, and inspected. Case histories of successful applications of the Polyken method are cited. An additional section concerns specifications, surface preparations, taping and wrapping, inspecting, repair, and special wraps for welded pipe.

The closing section lists product properties of the tape by various components such as adhesive, backing, etc. Pipe coverage data is also given for all widths of tape.

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ZF

Chemical Index

537

The Reilly Tar & Chemical Corporation, Indianapolis, Indiana, has just published their 1957 edition of the **Reilly Chemical Index.** The brochure contains information on eight new compounds developed by Reilly during 1956.

The Index also contains a short description of all the chemicals produced by the company. They are listed alphabetically and according to classes. Many of these chemicals are available in commercial quantities. Those available on a limited basis will be produced commercially when demand warrants.

Right Angle Speed Reducers

538

The Falk Corp., Milwaukee, Wisconsin, has just published a bulletin that combines in one book complete information on the company's lines of **Concentric Shaft and Right Angle Speed Reducers** for applications up to 140 hp.

Horsepower and torque ratings are given, as well as dimensions, overhung load and thrust capacities, and application pictures. Horsepower selection tables have been revised to show at a glance 1) the standard output speeds that may be obtained with commonly used input speeds, and 2) the full range of hp ratings available for each standard output speed.

Silicone Masonry Water Repellents

539

General Electric Company Silicon Products Department, Waterford, N. Y., has just released a brochure on **Silicone Masonry Water Repellents,** that describes the various benefits provided by silicon masonry water repellents and specifications for applying them.

This new brochure is illustrated by photographs of laboratory tests showing the effectiveness of silicones in minimizing water absorption, efflorescence, spalling and cracking. Also included are photographs of typical commercial and institutional masonry structures treated with silicones.

Water & Waste Treatment Equipment

540

Infilco Inc., Tucson, Arizona, has just published a bulletin on **Products and Processes.** The bulletin comprises 32 pages, fully illustrated, and deals with all water and waste treatment equipment designed and manufactured by the company.

Containing cross-references for all detailed bulletins devoted to specific equipment in municipal, industrial, sewage and industrial waste treatment fields, it is a handy informational catalog that will become an essential part of the libraries of engineers and of those concerned with such problems.

Balanced Valve Regulators

541

Rockwell Manufacturing Co., Pittsburgh, Pa., has issued a new revised 12-page, photo-illustrated bulletin describing Rockwell's **"014" Low-pressure Balanced Valve Regulators.**

Some of the new features in the revised version include: A detailed schematic drawing illustrating the use of the Rockwell "173" high-pressure regulator for pilot-loading of the "014"; and a similar drawing showing use of the Rockwell type 39 power pilot regulator for the same purpose, with the help of a new adapter which facilitates mounting.

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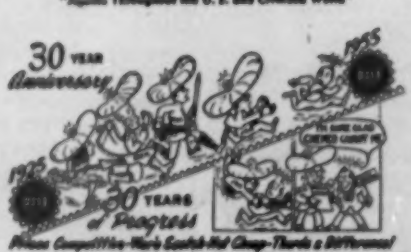

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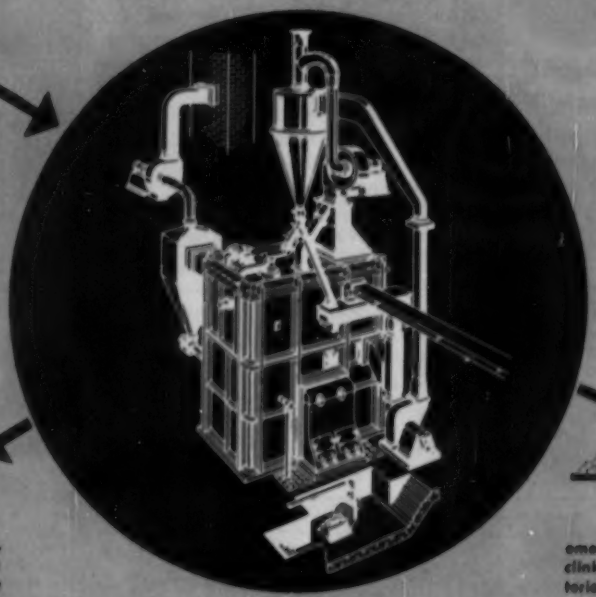

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Analytical-Grade Ion-Exchange Resins

542

Bio-Rad Laboratories, Berkeley, Calif., has just published a new folder, identified as Price List "M", that contains in addition to price information on **Analytical-Grade Anion Exchange Resins**, cation exchange resins, and monobed resins, considerable additional data of potential value to the laboratory worker.

A section devoted to considerations in the selection of a specific ion-exchange resin discusses the effect of the anion exchanger functional group, the effect of cross linkage, and the effect of particle size. This information is related to an extensive tabulation of properties of four groups of resins. Data on effective pore size, swelling volume, and exchange capacity is included with the materials listed. In addition, there is a list of specific types of resins which can be produced and a bibliography of books and reviews pertaining to the subject of ion exchange.

Water Filters

543

Commercial Filters Corporation, Melrose, Mass., has just published a booklet on **Fulflo Filters For Water and Aqueous Liquids.**

Fully illustrated, the booklet contains technical data on each model, including number of gallons filtered per minute, operating pressures, tube lengths, pipe sizes, inlet-outlet sizes, height and weight. Chart indicates pressure drop in psi across a new Honeycomb Filter at various flow rates up to 6 gpm.

According to the booklet, a major advantage of Honeycomb filter tubes is their availability in a wide range of positively controlled densities to attain optimum filtration regardless of operating conditions.

Water Service Products

544

The Welsbach Corporation, Kitson Valve Division, Philadelphia, Pa., has just published a catalog for **Water Utilities.**

This catalog contains approximately 125 pages and describes over 500 different styles and sizes of corporation stops, curb stops, service fittings, rough plumbing and tapping machines for water utilities and drainage fittings for sewerage disposal.

Diaphragm Control Valves

545

Minneapolis-Honeywell Regulator Company, Valve Division, Philadelphia, Pa., has just issued two new specifications giving details of construction on **Single-Seated and Double-Seated Honeywell Series 800 Diaphragm Control Valves.**

These specifications include sizes, materials, plug characteristic curves, dimensions and a cross-section drawing of each type.

Gratings And Treads

546

Blaw-Knox Company, Pittsburgh, Pa., has just released an informative, illustrated bulletin on **Grating And Treads.**

This new bulletin presents descriptions on electroforged, riveted, rectangular, diagonal, "U" type and "T" type interlocked grating and treads. Tables on safe loads and information necessary to specify are also included in the bulletin.

Float Valves

547

Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., has just published a 16-page technical bulletin explaining the features of the **Golden-Anderson Cushioned Float Valves.**

Parts lists, dimensions, approximate shipping weights for various sizes, operation, installation and other pertinent information on each of the various types of float valves is contained in this new catalog.

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INDEX TO ADVERTISERS

A

Albright & Friel, Inc. 145A
Alvord, Burdick & Howson 145A
*American Vitrified Products Co. 38A
*Anthracite Equipment Corp. 141A
Aqua Survey & Instrument Co. 141A

B

Badger Meter Mfg. Co. 39A
Baffa, John J. 145A
Baker, Jr., Inc., Michael 145A
Betz Laboratories 145A
*B-I-F Industries, Inc. 17A-35A-117A
*Blackburn-Smith Mfg. Co. 139A
Black & Veatch 145A
Bogart & Childs 145A
Bowe, Albertson & Associates 145A
Boyle Engineering 145A
Buck, Seifert and Jost 145A
Buffalo Meter Co. 25A
*Builders-Providence, Inc. 17A-31A-117A
Burgess & Niple 145A
Burns & McDonnell 145A
Byers Company, A. M. 125A

C

Calgon, Inc. 12A
Camp, Dresser & McKee 145A
Capitol Engineering Corporation 145A
Carborundum Company 26A
Cast Iron Pipe Research Ass'n 8A-9A
Centriline Corp. 116A
*Chemical Equip Co. 142A
*Chain Belt Co. 33A
Chester Engineers, The 145A
*Chicago Bridge & Iron Co. 27A
*Chicago Pump Company 105A
*Cleveland Trencher Co., The 133A
Clow & Sons, James B. 107A
Columbia Southern Chemical Co. 24A
*Combustion Engineering, Inc. 143A
Consoer, Townsend & Associates 145A
Cotton, Pierce, Stroander, Inc. 145A

D

Darling Valve & Mfg. Co. 13A
De Leuw, Cather & Company 145A
DeZurik Shower Company 123A
Dixie Tank & Bridge Co. 122A
*Dorr-Oliver, Inc. ..... Third Cover
Durajoint Technical Information 135A

E

Eddy Valve Co. 11A
Ellis & Ford Mfg. Co. 141A

F

Fairbanks-Morse & Co. 6A-7A
Fay, Spofford & Thorndike, Inc. 145A
Fine Organics, Inc. 132A
Finkbeiner, Pettis & Strout 145A
*Fischer & Porter Co. 47A
Flexible Inc. 110A
Ford Meter Box Co. 124A
Foxboro Co., The 127A
Freese, Nichols & Turner 146A

G

Gannett Fleming Corddry and Carpenter, Inc. 146A
Gilbert Associates, Inc. 146A
Glace & Glace 146A
Glenfield & Kennedy, Inc. 108A
*Graver Water Conditioning Co. 19A-20A
Greeley & Hansen 146A

H

*Hardinge Company, Inc. 130A
Haskins, Riddle & Sharp 146A
Havens & Emerson 146A
Hayden, Harding & Buchanan, Inc. 146A
Hazen & Sawyer 146A
Healy-Ruff Company 138A
Hersey Manufacturing Company 22A
Henningson, Durham & Richardson 146A
Homelite Corp. 3A
Homestead Valve Mfg. Co. 15A
Hotel Jefferson 138A
*Hydraulic Development Corp. 140A

I

Industrial Chemical Sales 14A
Infilco Inc. 43A

J

Jennings-Lawrence Co., The 146A
Jones, Henry & Williams 146A
*Johns-Manville 46A-129A
Johnson, Inc., Edw. E. 142A

K

Keasbey & Mattison Company 48A
Kenan & Associates, R. L. 146A
Kennedy, Clyde C. 146A
Klett Manufacturing Co. 106A
Knowles, Inc., Morris 146A

L

Lanning Sanitary Engineering Co., Inc. 146A
Layne & Bowler, Inc. 23A
*Leopold & Co., F. B. 32A
Lock Joint Pipe Company ..... Second Cover
Lockwood Greene Engineers, Inc. 146A
Lozier Co., Wm. S. 146A

M

*M & H Valve & Fittings Co. 112A
MCG Co., Inc. 138A
Meadows, W. R. 135A
Metcalf & Eddy 146A
*Millipore Filter Corp. 51A
Minneapolis-Honeywell Reg. Co. 42A
Modern Swimming Pool Co., Inc. 141A
Morton Salt Co. 111A
*Mueller Company 36A-37A-109A
*Multiplex Mfg. Co. 131A

N

*National Water Main Clean. Co. 120A
*Neptune Meter Company 52A
Nussbaumer, Clarke & Velzy, Inc. 146A

O

*Olin Mathieson Chem. Corp. 118A
Oliver Corp. 29A
*Omega Machine Co. 17A-35A-117A

P

*Pacific Flush Tank Company 10A
Parsons, Brickerhoff, Hall & MacDonald 146A
Pennsalt Chemicals Corp. 115A
*Permutit Company 4A
*Phipps & Bird, Inc. 140A
Pirnie Engineers, Malcolm 146A
Pitometer Associates, Inc., The 146A
*Pollard Co. Inc., Jos. G. 18A
Pratt Co., Henry 126A
Pressure Concrete Co. 139A
*Price Bros. Company 119A
Purcell, Lee T. 147A

R

Riddick, Thomas M. 147A
Robert and Company Associates 147A
*Roberts Filter Co. 41A
Rockwell Mfg. Co. 21A

S

Sirrine Company, J. E. 147A
Smith & Associates, Benjamin L. 147A
*Smith, S. Morgan 28A
*Smith Mfg. Co., A. P. 34A
Standard Dry Wall Products Co. 128A
Stanley Engineering Company 147A
Sparling Meter Co., Inc. 134A
Spoolmon Elevated Tank Co. 140A
Stilson & Associates, Alden E. 147A
Synchro-Start Products, Inc. 106A

T

*Tennessee Corporation 49A

U

Uhlmann & Associates 147A
*U. S. Pipe & Foundry Co. 44A-45A
U. S. Rubber 121A

V

Vulcan Materials Co. 40A

W

*Walker Process Equipment, Inc. 30A
*Wallace & Tiernan, Inc. ..... Back Cover
Wertz Engineering Co., Inc. 147A
Weston & Sampson 147A
Western Machy Co. 144A
Wheeler Mfg. Co., C. H. Div. Economy Pumps 114A
Whitman & Howard 147A
Whitman, Requardt & Associates 147A
Wood Co., R. D. 136A-137A
Woodward Iron Co. 50A
*Worthington Corp. 16A
*Worthington-Gamon 31A

Y

*Yeomans Bros. 113A

Z

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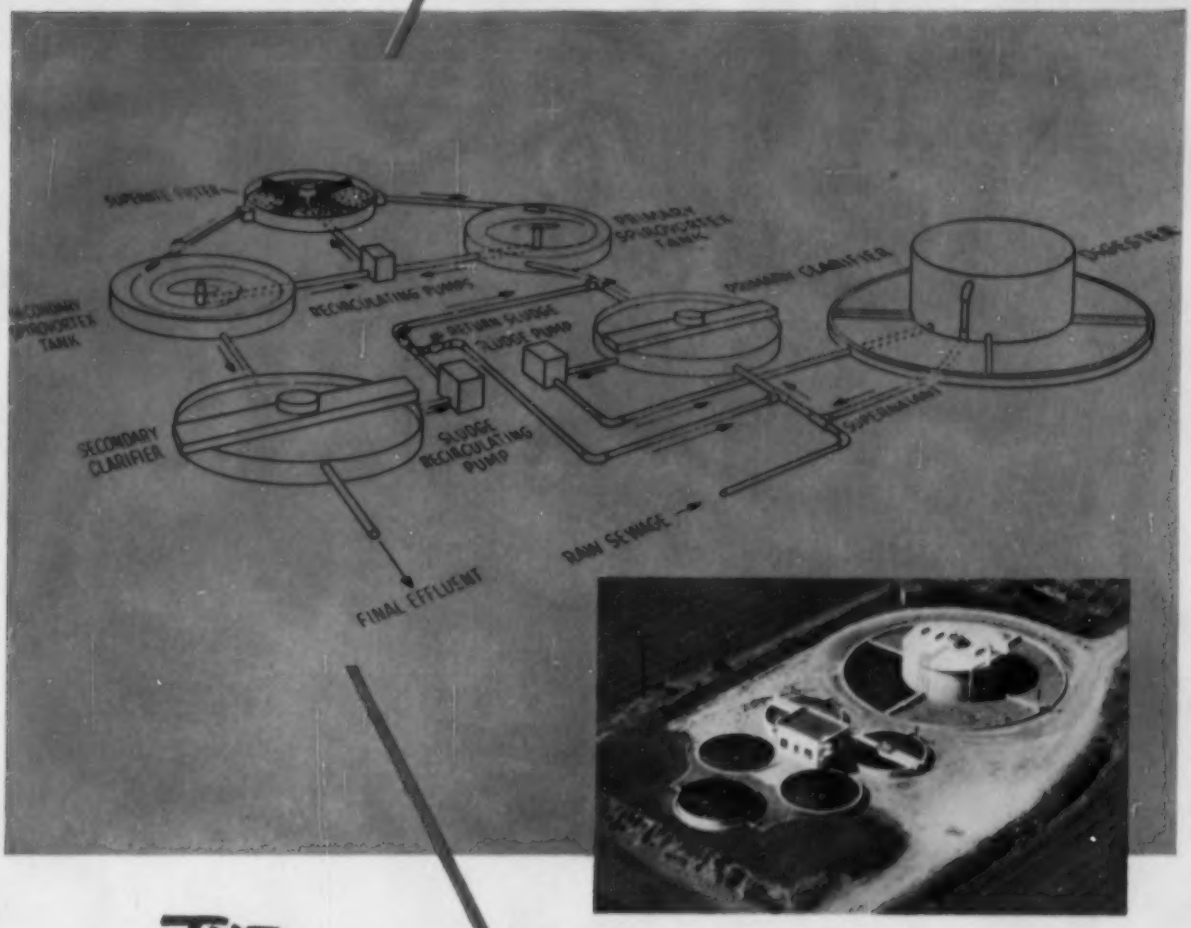

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